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WORK PLAN

FOR WATERSHED PROTECTION
AND FLOOD PREVENTION

ANDERSON RIVER WATERSHED

Perry, Spencer, Dubois, and Crawford
Counties, Indiana



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A D D E N D U M

ANDERSON RIVER WATERSHED

INTRODUCTION

This addendum was developed in accordance with phase-in procedures adopted by the Water Resources Council for level C plans for which field studies, analysis, and evaluations were completed as of October 25, 1973, and which have been formulated in accordance with Senate Document 97, as supplemented and amended.

The Anderson River Watershed Plan dated July 1975 was developed using 1973 prices for structural installation and non-agricultural benefits; a $5 \frac{7}{8}$ percent discount rate; adjusted normalized prices for agricultural products and for structural operation and maintenance; recreation values based on Water Resources Council Principles and Standards.

Part I of this addendum shows the effect of evaluating the structural measures using 1975 installation costs, a $6 \frac{1}{8}$ percent discount rate, current normalized prices for agricultural products, current prices for values other than agricultural products, and current recreation values in the evaluation of the project structural measures.

Part II of the addendum displays an abbreviated environmental quality plan. This plan is a summary of the environmental conditions which exist in the watershed and the effects which the plan will have on the environment.

Part III of the addendum displays the effects of the selected plan as evaluated for each of the separate accounts - national economic development, environmental quality, regional development, and social well-being. Values for costs, prices, and rates are those of the July 1975 plan.

A D D E N D U M P A R T 1

ANDERSON RIVER WATERSHED

PLAN

EFFECT OF USING CURRENT VALUES FOR EVALUATIONS

The following tabulation shows the effect of evaluating the structural measures using a 6 1/8 percent discount rate, 1975 installation costs, current prices for values other than agricultural products, current normalized prices for agricultural products, and current recreation values.

Average Annual Costs	\$556,389
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Average Annual Benefits:

Primary Benefits	661,301
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Secondary	134,903
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Total Benefits	\$796,204
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Benefit to Cost Ratios:

Total Benefits to Cost	1.4:1.0
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Without Secondary Benefits	1.2:1.0
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Tables with details of these costs and benefits are on Addendum, Part 1, pages Add-2 through Add-10.

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TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Anderson River Watershed, Indiana

ESTIMATED COST (DOLLARS) 1/																	
Installation Cost Item	Unit	Number		P.L. 566 Funds					Other Funds					Subtotal Other	TOTAL		
				Fed. Land SCS 2/	Non-Fed. Land SCS 2/	Land FS 2/	Subtotal P.L. 566	Federal Land		Non-Federal Land							
								SCS 2/	FS 2/	SCS 2/	FS 2/						
LAND TREATMENT																	
Land Areas																	
Cropland	Ac.	10,737			10,737								878,126		878,126	878,126	
Pastureland	Ac.	18,002			18,002								1,668,869		1,668,869	1,668,869	
Forest Land	Ac.	10,460			10,500								62,263		62,263	62,263	
Other Land	Ac.	3,343			3,343								79,015		79,015	79,015	
Technical Assistance																	
TOTAL LAND TREATMENT				Ac.	40	42,542		42,582		421,716	30,284		1,017	220,576	28,476	249,052	701,052
STRUCTURAL MEASURES																	
Construction																	
Fl. Retarding Strs.	No.	2	44		46		102,031	1,757,277		1,859,308						1,286,396	1,859,308
M.P. Structures	No.	1	2		3		284,589	378,875		663,464	1,186,156		100,240			1,949,860	1,949,860
Rec. Facilities	No.	1	1		2			302,897		302,897	2,260		927,730			1,231,474	1,534,371
M & I Outlet Fac.	No.	1	1		2								13,560			15,820	15,820
Channel Work (N) 3/	Mi.		10.5		10.5			38,141		38,141						38,141	38,141
Subtotal Construction							386,620	2,477,190		2,863,810	1,188,416		927,730	417,544		2,533,690	5,397,500
Engineering Services							46,394	291,953		338,347	142,790		92,773	25,963		261,526	599,873
Relocation Payments								10,172		10,172				14,123		14,123	24,295
Project Administration																	
Constr. Inspection							188,733	333,613		522,346	226		92,773	1,356		94,355	616,701
Other							169,944	212,292		382,236	3,219		92,773	81,324		177,316	559,552
Relocation Assistance,																	
Advisory Service								1,695		1,695				1,695		1,695	3,390
Other Costs - Land Rights								91,643		91,643	41,133			411,105		452,238	543,881
TOTAL STRUCTURAL MEASURES							791,691	3,418,558		4,210,249	1,375,784		1,206,049	953,110		3,534,943	7,745,192
TOTAL PROJECT							791,691	3,840,274	30,284	4,662,249	1,375,784	1,207,066	3,799,696	89,722		6,472,268	11,134,517

1/Price Base 1975
2/Price Base 1975
3/Price Base 1975

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Anderson River Watershed, Indiana

(Dollars) 1/

Item	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds				Total	
	Constr.	Engrg.	Land	Reloc.	Land	Reloc.	Engrg.	Constr.	Other	Inst. Cost
Floodwater Retarding Structures										
(Upper Main Above Hwy. 62)										
U-4	92,044	11,045			103,089				5,876	108,965
U-6	38,779	4,653			43,432				4,113	47,545
U-7	34,844	4,181			39,025				2,712	41,737
U-8	28,473	3,417			31,890				1,639	33,529
U-17	42,729	5,127			47,856				4,520	52,376
U-18	34,909	4,189			39,098				113 ^{2/}	39,211
U-19	24,017	2,882			26,899				1,785	28,684
U-20	36,559	4,387			40,946				2,011	42,957
U-34	40,426	4,851			45,277				4,814	50,091
U-35	42,415	5,090			47,505				3,334	50,839
U-36	49,549	5,946			55,495				5,243	60,738
U-37	63,355	7,603			70,958				8,452	79,410
U-38	67,117	8,054			75,171				113 ^{2/}	75,284
Subtotal	595,216	71,425			666,641				44,725	711,366
(Upper Main below Hwy. No. 62 to Hurricane Creek)										
U-12	41,007	4,921			45,928				22,114 ^{3/}	68,042
U-28	30,625	3,675			34,300				2,723	37,023
U-29	33,935	4,072			38,007				2,712	40,719
U-30	42,217	5,066			47,283				3,390	50,673
U-31	33,601	4,032			37,633				2,057	39,690
Subtotal	181,385	21,766			203,151				32,996	236,147

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Anderson River Watershed, Indiana

(Dollars) 1/

Item	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds				Total Inst. Cost
	Constr.	Engrg.	Land	Reloc. Pymts.	Total P.L. 566	Constr.	Engrg.	Land Rights	Total Other
(Hurricane Creek System)									
L-5	35,307	4,237			39,544			1,989	1,989
L-6	36,185	4,392			40,527			1,865	1,865
L-7	41,950	5,034			46,984			3,774	3,774
L-13	36,178	4,341			40,519			1,356	1,356
L-17	30,659	3,679			34,338			2,961	2,961
L-18	33,682	4,042			37,724			2,204	2,204
L-21	44,644	5,357			50,001			12,882	12,882
L-26	26,295	3,155			29,450			2,418	2,418
L-29	33,479	4,017			37,496			2,712	2,712
L-32	60,366	7,244			67,610			2,712	2,712
L-55	60,431	7,252			67,683			28,9964/	28,996
Subtotal	439,176	52,700			497,876			63,869	63,869
(Blackhawk Branch System)									
L-48	36,544	4,385			40,929			8,475	8,475
L-50	30,733	3,688			34,421			2,328	2,328
L-51	35,708	4,285			39,993			3,390	3,390
L-52	36,732	4,408			41,140			11,752	11,752
L-53	26,789	3,215			30,004			4,543	4,543
L-54	33,566	4,028			37,594			8,034	8,034
L-56	24,016	2,882			26,898			3,932	3,932
L-59	27,301	3,276			30,577			5,017	5,017
Subtotal	251,389	30,167			281,556			47,471	47,471
									329,027

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Anderson River Watershed, Indiana

(Dollars) 1/

Item	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds				Total Inst. Cost		
	Constr.	Engrg.	Land Rights	Reloc. Pymts.	Total P.L.566	Constr.	Engrg.	Land Rights		Reloc. Pymts.	Total Other
(Lower Main below Blackhawk Branch)											
L-30	97,553	11,706			109,259			25,086		25,086	134,345
L-35	41,137	4,936			46,073			8,170		8,170	54,243
L-36	30,934	3,712			34,646			3,096		3,096	37,742
L-37	36,727	4,407			41,134			8,362		8,362	49,496
L-38	22,205	2,665			24,870			2,034		2,034	26,904
L-39	41,578	4,989			46,567			9,944		9,944	56,511
L-40	50,794	6,095			56,889			28,024 ^{5/}		28,024	84,913
L-45	25,877	3,105			28,982			2,260		2,260	31,242
L-46	45,337	5,440			50,777			6,780		6,780	57,557
Subtotal	392,142	47,055			439,197			93,756		93,756	532,953
Multiple Purpose Structures											
U-1	284,589	34,151			318,740	1,186,156	142,338	40,906 ^{6/}		1,369,400	1,688,140
M&I Fac.						2,260	452			2,712	2,712
Rec. Fac.						927,730	92,773			1,020,503	1,020,503
U-10	331,963	49,517			456,853	80,696		67,461 ^{7/}	14,123	162,280	619,133
Rec. Fac.	302,897	21,357 ^{9/}	65,201 ^{8/}	10,172	350,696	303,744	21,357 ^{9/}	43,392 ^{10/}		368,493	719,189
L-24	46,912	5,632	26,442		52,544	19,544	2,346	13,221		35,111	87,655
M&I Fac.						13,560	2,260			15,820	15,820
Channel Work(N) ^{11/}											
Main Channel	38,141	4,577			42,718			4,441		4,441	47,159
TOTAL	2,863,810	338,347	91,643	10,172	3,303,972	2,533,690	261,526	452,238	14,123	3,261,577	6,565,549
PROJECT ADM.					906,277					273,366	1,179,643
GRAND TOTAL					4,210,249						7,745,192

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Anderson River Watershed, Indiana

<u>1/</u>	Price Base 1975.
<u>2/</u>	Cost for a "USE PERMIT" on U.S. Forest Service land.
<u>3/</u>	Includes \$11,300 for raising gravel road.
<u>4/</u>	Includes \$13,560 for raising gravel road and \$4,520 for house.
<u>5/</u>	Includes \$14,012 for road modification.
<u>6/</u>	Includes \$226 for "USE PERMIT" on U.S. Forest Service land (\$113 water supply and \$113 flood control), \$23,130 for 70 grave displacements and \$16,950 for 3 miles of telephone line modification.
<u>7/</u>	Includes \$2,260 legal fees, \$10,170 for buildings, \$2,825 for utility line modification.
<u>8/</u>	Includes \$10,170 for buildings, and \$2,825 for utility line modification.
<u>9/</u>	A & E Engineering contract cost shared: \$21,357 for P.L. 566 funds and \$21,357 for Other funds.
<u>10/</u>	Includes \$5,650 for legal fees.
<u>11/</u>	This is an unmodified, well defined, natural channel.

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TABLE 2A - COST ALLOCATION AND COST SHARING
Anderson River Watershed, Indiana

(Dollars) 1/

Item	COST ALLOCATION				COST SHARING							
	Purpose				P.L. 566 Funds							
	Flood Prevention	Recreation	Municipal Water	Total	Flood Prevention	Recreation	Municipal Water	Total	Flood Prevention	Recreation	Municipal Water	Total
Structures Floodwater Retarding, 46 Multiple Purpose Structure U-1 Rec. Facilities M & I Outlet Fac. Structure U-10 Rec. Facilities Structure I-24 M & I Outlet Fac. Channel	2,365,238			2,365,238	2,082,421			2,082,421	282,817			282,817
	326,725	1,354,551	6,864	1,688,140	318,740			318,740	7,985	1,354,551	6,864	1,369,400
		1,020,503		1,020,503						1,020,503		1,020,503
			2,712	2,712							2,712	2,712
	296,212	322,921		619,133	287,612	169,241		456,853	8,599	153,681		162,280
	61,877	719,189		719,189	52,544	350,696		350,696	9,333	368,493		368,493
			25,778	87,655	52,544			52,544			25,778	35,111
			15,820	15,820							15,820	15,820
	47,159			47,159	42,718			42,718	4,441			4,441
	GRAND TOTAL	3,097,211	3,417,164	51,174	6,565,549	2,784,035	519,937			313,175	2,897,228	51,174

1/ Price Base 1975

1/ Price Base 1975

January 1976

TABLE 4 - ANNUAL COST
Anderson River Watershed, Indiana

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
All Structural Measures	403,190	80,757	483,947
Project Administration	72,442	: : : : : : : : : : : : : :	72,442
GRAND TOTAL	475,632	80,757	556,389

1/ Price base: Installation and O&M 1975

2/ 100 years at 6 1/8 percent interest.

3/ Includes \$72,392 for operation, maintenance, and replacement for the recreational development.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Anderson River Watershed, Indiana

(Dollars) 1/

Item	<u>Estimated Average Annual Damage</u>		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	353,885	190,151	163,734
Other Agricultural	67,025	31,463	35,562
Nonagricultural			
Road and Bridge	12,323	4,423	7,900
Subtotal	433,233	226,037	207,196
Erosion			
Floodplain Scour	8,045	3,831	4,214
Indirect	44,556	23,046	21,510
TOTAL	485,834	252,914	232,920

1/ Price Base: Current normalized prices as approved by the Water Resources Council - November 1975 for agricultural items and 1975 for other items.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Anderson River Watershed, Indiana

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/						3/ Avg. Annual Cost	Benefit Cost Ratio
	2/ Damage Reduction	Changed Land Use	More Intensive Use	Recrea- tion	M & I Water Supply	Secon- dary	Total Benefit	
All Structural Measures	225,932	13,170	21,536	394,031	6,632	134,903	796,204	1.6:1
Project Administration	: : : : : : : : : : : :	: : : : : : : : : : : :	: : : : : : : : : : : :	: : : : : : : : : : : :	: : : : : : : : : : : :	: : : : : : : : : : : :	: : : : : : : : 72,442	: : : : : : : : : : : :
GRAND TOTAL	225,932	13,170	21,536	394,031	6,632	134,903	796,204	1.4:1

- 1/ Price base: Current normalized prices as approved by the Water Resources Council - November 1975, for agricultural items and 1975 prices for other items.
- 2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$6,988 annually.
- 3/ From Table 4.

ANDERSON RIVER WATERSHED

II. ABBREVIATED ENVIRONMENTAL QUALITY PLAN

ENVIRONMENTAL PROBLEMS

Land Quality

Inherent low fertility and very severe erosion are problems characteristic of approximately 65,000 acres, or two-thirds of the watershed soils. An estimated 8,700 acres of these soils are under cultivation, with one year out of three devoted to row crop production.

Sheet erosion is active throughout the watershed's rolling upland areas and is the primary sediment source. Approximately 90 percent of watershed soils have erosion hazards. Soil losses on cropland in the upland areas range typically between 3 and 10 tons per acre per year and are in excess of the allowable 3 tons per acre per year. Sheet erosion rates can run as high as 26 tons per acre per year on steep soils that are plowed and planted to continuous row crops. Erosion rates on upland pasture and grazed forest land range typically between 3 and 7 tons per acre per year and generally are at or above the allowable limit.

Gully erosion is prevalent in isolated areas throughout the watershed. Areas affected are the more steeply rolling uplands, and are primarily idle land, cropland, or pasture. Gully erosion rates range between 20 and 35 tons of soil loss per acre annually.

Approximately 400 acres of critically eroded land exist within the watershed. This figure includes areas of gully erosion, rill erosion and severe sheet erosion which typically occur on small steep upland plots that range in size from 1 to 15 acres.

An estimated 369 acres are seriously affected by flood plain scour. All of the flood plain soils are affected to some degree due to flood waters. Average annual damages from flood plain scour are estimated at \$5,241.

Streambank erosion also occurs throughout the watershed, due in part to debris blocks or large trees. It is not considered serious.

Total gross erosion on the watershed averages 553,892 tons per year. Overall watershed erosion is approximately 98 percent attributable to sheet erosion, 1.5 percent to gully erosion, and 0.5 percent to streambank erosion and flood plain scour.

Floodwater Damage

Damages to crops, pastures, other agriculture properties, roads, and bridges are the principal floodwater problems in the watershed. These problems are associated with storms which generally occur two to three times per year. Twenty nine percent of these flood producing storms occur during May, June, and July when crops are most susceptible to damage.

The agriculture flood plain covers 8,064 acres and includes 6,372 acres of cropland valued at \$4,300,000. The average annual flood affects 5,829 acres.

Farmers have reported crop losses ranging from 20 percent up to 100 percent from the most severe floods.

The flood producing capability of these flood plain soils is not realized because of flooding. Farmers can not economically manage these soils for their potential due to the risk of flood damage.

Based on the monthly probability of flood occurrence, crop and pasture damages for future conditions without project are estimated at \$117,311 for the annual flood, \$173,784 for the 10 year flood, and \$207,220 for the 100 year flood (floods that have a statistical probability of occurring once in one, ten and one hundred years respectively).

Time and expense are involved in removing debris from flood plain areas, repairing fences, farm roads, and tile outlets, removing sediment from drainage ditches and controlling weed infestations carried in by floodwaters.

Interruption of travel, mail and school bus service, and delay and inconvenience in feeding livestock are serious problems during flood periods. Flood damage is extensive to county roads and bridges in the watershed. Bridge foundations are undercut by floodwaters and in some cases are rendered unsafe for vehicular use. Road and bridge repairs are expensive and often travel is interrupted until such repairs are made.

Sediment Damage

Sediment damage occurs predominately in the upper reaches of watershed tributary streams. Channels in these areas fill with gravel and sand at major gradient breaks. Farm operators have had to remove sediment accumulations from these channels to prevent excessive flooding and rising ground water levels on adjoining lands.

Sand and silt particles are deposited in the larger drainageways causing channel flow restrictions and increasing the amount of flooding.

Of the 553,892 tons per year of gross erosion, an estimated 40,000 tons are flushed from the watershed into the Ohio River annually.

Plant and Animal Resources

Cropland acreages are decreasing and are being converted primarily to forest land or pastureland. Wildlife habitat of forest land-pasture land "edge" are increasing. This benefits species such as deer and gray squirrel. Forest land-cropland "edge" is decreasing. This will be detrimental to species such as bobwhite quail, cottontail rabbit, and fox squirrel.

Spring and summer flooding destroys eggs and the young of ground nesting animals and birds. Occasionally a brood year of a species in flooded areas could be adversely impacted, and, in some circumstances, completely

eliminated by flooding. Effects of sediment laden floodwater and the decrease in water quality on fish have not been specifically evaluated.

Wildlife habitat for upland game and song birds is adequate to support current populations. Deer populations are below carrying capacity of available habitat because of illegal hunting activities and dog packs.

Waterfowl in the area are primarily limited to wood ducks. The lower main stem of Anderson River and some upstream reaches serve as important nesting and brooding grounds.

Recreation

Population growth, rising standards of living, and increased amounts of time for leisure activities are creating increased demands for outdoor, water based recreation activities in the watershed and surrounding areas.

The Indiana State Recreation Plan, September, 1970, states that this area is deficient in facilities to meet these demands.

The recreation goal of the U.S. Forest Service is to help meet the demand for a regional park and to provide facilities that would encourage use of our publicly owned forest lands.

Water Supply

Based on their consulting engineers report, the Archabbey at St. Meinrad does not have enough existing water supply available to meet the projected needs beyond 1985. Their report further states that based on projected people that will be residing on the Archabbey grounds by year 2020 an additional supply of 100 acre-feet is recommended to be established for future reserve.

The consulting engineers recommended surface storage over ground water due to the very limited supply of ground water in this area, and the poor results of several test wells drilled in the past 10 years.

Existing municipal water supply for the Town of Birdseye is considered adequate by their consulting engineers for both present needs and future growth. Water is not considered adequate, however, for future industrial growth. An additional 100 acre-feet of water supply is necessary to attract industry which will in turn stimulate the town's economy.

Water Quality

In general, the quality of surface water in the Anderson River Watershed is very good. However, some problem areas were identified in a study conducted by the U.S. Geological Survey. These include isolated areas of somewhat high concentrations of nitrates, fecal coliform, fecal streptococci, and suspended sediment. At three locations abandoned surface coal mining operations were causing alterations of stream water quality downstream. Increased concentrations of aluminum, iron, and manganese and lower pH values were the observed effects.

The sampling was conducted in January, 1974, after a snow melt, and stream discharges were fairly high. This might indicate that concentrations of suspended sediment, fecal bacteria, and nitrate content could be expected to be lower during periods of low flow because of reduced surface runoff.

Land Use Planning

Current and projected population increases are resulting in continuing land and space competition. The resulting stress on the Natural Resources points out the need for land use planning to provide for the orderly development of the watershed area.

Authority has been delegated to counties by the State to develop and implement their own land use plan. None of the four counties involved in this watershed project have developed such a plan.

COMPONENT NEEDS

1. Protect land quality by reducing sheet, gully and channel erosion.
2. Provide floodwater damage reduction to cropland, pastureland, other agricultural properties, roads and bridges.
3. Reduce sediment concentrations in streamflows.
4. Management and enhancement of wildlife resources.
5. Provide public outdoor recreation facilities to help meet the growing demand in the area and region.
6. Provide additional water supply for the Archabbey at St. Meinrad and industrial water for the Town of Birdseye.
7. Improve the present high level of surface water quality.
8. Develop and implement comprehensive land use plans at local and regional levels of concern.
9. Stabilize approximately 100 acres of abandoned strip mining lands.
10. Reduce the amount of illegal hunting and dog pack effects on the deer population.

Plan Elements

1. Implement conservation land treatment practices and measures that will adequately treat 42,582 watershed acres during the project installation period. This land treatment will be voluntarily applied by landowners throughout the entire watershed and will supplement the on-going land treatment program. Total estimated cost is \$2,999,403.

Land treatment measures to be applied to 10,737 acres of cropland include contour farming, grade stabilization structures, subsurface drains, drainage field ditches, diversions, grassed waterways, terraces, and conservation cropping systems.

Land treatment measures to be applied to 18,002 acres of pastureland include pasture and hayland management, pasture and hayland planting, ponds, and spring development.

Land treatment to be applied to 10,460 acres of private forest land include tree planting and deferred grazing. The existing program

followed by the U.S. Forest Service on Hoosier National Forest land will be continued.

2. Install 46 small, single purpose floodwater retarding reservoirs, 1 multiple purpose reservoir for flood prevention, recreation and industrial water supply, 1 multiple purpose structure for flood prevention and recreation, 1 multiple purpose structure for flood prevention and municipal water supply, and approximately 10.5 miles of channel work on the Anderson River main stem consisting of debris removal and the removal of hazardous trees from the channel flow area without excavation. Total estimated cost of installation is \$4,254,268.
3. Apply vegetative, structural measures, and land leveling on approximately 100 acres of abandoned strip mine. Total estimated cost is \$750,000.
4. Apply wildlife upland habitat management to cropland, grassland, and forest land where applicable.
5. Vegetate critically eroded areas with erosion controlling species of trees, shrubs, vines, grasses, and legumes.
6. Provide a beach, bathhouse, 20 camping units, 20 picnic units, 1 group picnic unit, 1 boat ramp, a sewage system, water system, two-way black-top access roads, and parking facilities at reservoir No. U-1. Total estimated installation cost is \$903,100.
7. Provide a beach, bathhouse, 60 camp sites, 1 boat ramp, 18 boat docks, 2 toilet units, 1 shower unit, a sewage system, water system, and associated roads and parking areas at reservoir No. U-10. Total estimated cost including 430 acres of land acquisition is \$636,450.
8. Provide 100 acre-feet of storage at reservoir No. L-24 for the St. Meinrad Archabbey. Total estimated cost is \$36,813.
9. Provide 100 acre-feet of industrial water for the Town of Birdseye in reservoir No. U-1. Total estimated cost is \$8,475.
10. Identify and protect environmentally sensitive areas.
11. Give guidance to residential, industrial and agricultural developments so that environmental conflicts are minimized.
12. Identify and protect or preserve historical, cultural, and scenic values.
13. Protect the agricultural, food producing base of the area from developments from other uses.

The four counties involved in this watershed project currently have not developed a land use plan, even though the authority exists. Such a plan is beyond the scope of this study.

14. Study the effect of dog packs on the deer population and take steps necessary to eliminate their impact.
15. Study the effect of illegal hunting of deer and take steps necessary to eliminate the effect on deer population.

INSTITUTIONAL ARRANGEMENTS

Institutional arrangements available and needed for the implementation of the Environmental Quality Plan. Legal entities of government are in existence for the implementation of the Environmental Quality Plan. Local, State, and Federal programs are available to provide the needed financial assistance.

Local Programs and Sources

1. Anderson River Conservancy District - Has filed a letter of intent with the Farmers Home Administration to obtain a loan to help finance their share of initial project costs. The Conservancy District is responsible for all or part of the following costs:
 - a. Land rights and a portion of project administration and contract administration for all structural measures.
 - b. Municipal water storage on structure No. L-24.
 - c. Construction of structural measures.
2. Perry County Park and Recreation Board - Land acquisition and development of recreational facilities at reservoir U-10.
3. Town of Birdseye - Will pay for additional cost of 100 acre-feet of storage at reservoir U-1 for industrial water supply. This cost includes land rights, design, construction, and project administration on that portion of storage.
4. Local banks and Production Credit Association - Loans to landowners for their share of installing land treatment measures and practices.

State Programs

1. Indiana Department of Natural Resources
 - a. Forestation Program - Provide tree planting stocks and technical assistance.
 - b. Private Land Wildlife Habitat Improvement Program - Provide financial and technical assistance to create wildlife habitat on private lands.
 - c. Natural Resource Funds - Provide financial assistance for developing fish and wildlife habitat and recreational areas.
 - d. Conservation Officers - Provide enforcement of game laws.
2. State Planning Agency
 - a. Outdoor Recreation Division - Land acquisition and development of recreational facilities.

Federal Programs

1. U. S. Department of Agriculture

- a. Resource Conservation and Development - Financial and technical assistance involving human and natural resources. All portions of the watershed in Crawford, Perry, and Spencer Counties are included in the Lincoln Hills RC & D project, and all portions of the watershed in Dubois County are covered by Four Rivers RC & D.
- b. Rural Environmental Assistance Program - Provides cost sharing assistance to individual landowners for application of conservation practices.
- c. Loans and Advances - Provide loans and advances to sponsoring organizations.
- d. Funds for wildlife habitat improvement, watershed protection and timber stand improvement. Part of on-going program of U.S. Forest Service.

2. U. S. Department of Interior

- a. Pitman-Robertson Funds - Provides for wildlife research and financial and technical assistance in developing wildlife habitat areas. Administered by the State.
- b. Dingell-Johnson Funds - Provides for fishery research and financial and technical assistance in developing fishery habitat areas.
- c. Land and Water Conservation Fund - Provides for 1) acquisition of lands for Federally administered recreation areas and 2) matching grants for State recreation planning and State as well as local land acquisition and development, administered by the Bureau of Outdoor Recreation.

Technical assistance including educational and onsite assistance is available from:

- 1. Crawford, Perry, Spencer, and Dubois County Soil and Water Conservation Districts
- 2. Cooperative Extension Service
- 3. Indiana Department of Natural Resources
- 4. USDA, Soil Conservation Service
- 5. USDA, Forest Service
- 6. USDI, U.S. Fish and Wildlife Service
- 7. Bureau of Outdoor Recreation

EFFECTS

Installing Land Treatment Measures

- 1. Reduce annual erosion from an estimated 5.7 tons per acre to 4.4 tons per acre, a 23 percent reduction.
- 2. Improve quality and productivity of approximately 13,210 acres of

grassland.

3. Construct approximately 170 farm ponds.
4. Increase productivity of an estimated 5,480 acres of private forest land resources by intensified management practices.
5. Reduce sediment concentration in streams by 23 percent.
6. Reduce flood damage by 3 percent.
7. Improve wildlife habitat and populations by less intensive use of 10,737 acres of cropland.
8. Aesthetic and scenic values will be enhanced by the pleasing beauty and land contrasts of a well managed land environment.
9. Reduce cropland acreage by 7,665 acres.
10. Increase of pastureland acreage of 8,012 acres.
11. Increase of lands managed for forest land purposes by 1,978 acres.
12. Decrease in other land uses by 2,325 acres.
13. Stabilize 71 acres of critically eroding land.
14. Tree planting on 430 acres of land needing less intense use.
15. Improve wood duck nesting habitat with water impoundments associated with forest land.

Installing Floodwater Retarding Structures

1. Reduce average annual flooding damages by 45 percent.
2. Reduce flood plain scour erosion damages on 369 acres by an estimated 51 percent.
3. Reduce sediment concentrations in streams by 27 percent.
4. Increase agricultural production potential on flood plain soils.
5. Reduce wildlife losses due to flooding.
6. Create 1,103 acres of permanent surface water.
7. Create 623 acres of temporary surface water.

Reduction of Sediment Damage

1. Improve quality of water by reducing sediment concentration by 50 percent.
2. Eliminate unsightly bank erosion areas on 10.5 miles of channel bank.

3. Reduce amount of sediment that is washed into the Ohio River.
4. Reduce damages to roads and bridges.

Managing Wildlife Habitat and Resources

1. Increase numbers of wildlife by applying land treatment measures, and increasing acres of wildlife habitat by 1,811 acres.
2. Improve stream fishery by increasing low flow and release of cool, oxygenated water from reservoirs U-1 and U-10.
3. Increase fish numbers with 1,103 acres of permanent water.
4. Increase waterfowl numbers.
5. Protection of ground nesting species on the flood plain.

Recreation Development

1. Provide facilities for 2,500 people at one time at structures No. U-1 and U-10.
2. Provide facilities for 175,125 recreation visits annually.
3. Enable the public to make better use of Ferdinand State Forest and Hoosier National Forest.
4. Provide an opportunity for increased public fishing.

Municipal and Industrial Water Supply

1. Assure the Archabbey at St. Meinrad of an adequate water supply until at least the year 2020.
2. Assure the Town of Birdseye of an adequate supply of industrial water to meet anticipated future needs.

Surface Water Quality

1. Sediment concentrations in streams will be reduced by 50 percent.
2. Agriculture chemicals associated with sediment particles will be reduced by 50 percent in streams.

Developing and Implementing a Land Use Plan

1. Enhance the opportunity for academic, cultural, and recreational pursuits.
2. Preserve and protect historical, cultural, and scenic values identified in the area.
3. Guide residential, industrial, and agricultural development in a

manner that will reduce conflict with environmental values.

4. Improve living conditions by providing for waste and sewage treatment.

Stabilizing Abandoned Strip Mine Lands

1. Improve water quality downstream by raising pH to acceptable levels and eliminating increased concentrations of aluminum, iron, and manganese.

Eliminate Dog Packs and Illegal Hunting of Deer

1. Allow the deer population to increase to the carrying capacity of available habitat.

SELECTED PLAN
ANDERSON RIVER WATERSHED
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

Dollars 1/
(Average Annual)

<u>Components</u>		<u>Measures of Effects</u>	<u>Components</u>	<u>Measures of Effects</u>
Beneficial Effects			Adverse Effects	
A. The value of users of increased outputs of goods and services.			A. The value of resources required for a plan.	
	1. Flood prevention	177,235	1. Multipurpose reservoirs, M&I outlet facilities, flood prevention structures, and recreational facilities.	
	2. Recreation	394,031	Project construction	342,512
	3. Water supply	<u>6,632</u>	Project administration	61,540
Total Beneficial Effects		577,898	Office	80,757
			Total Adverse Effects	1481,809
			Net Beneficial Effects	93,089

1/ Amortized at 5 7/8 percent interest for 100 years.

July 1975

SELECTED PLAN
ANDERSON RIVER WATERSHED
REGIONAL DEVELOPMENT ACCOUNT

Dollars $\frac{1}{-}$

(Average Annual)

Components		Measure of Effects		Components		Measures of Effects	
		Indiana	Rest of Nation			Indiana	Rest of Nation
		Planning Region				Planning Region	Nation
		Number 13				Number 13	
A. Income				A. Income			
Beneficial Effects				Adverse Effects			
1. The value of increased output of goods and services to users residing in the region.				1. The value of resources contributed from within the region to achieve the outputs.			
a. Flood prevention				a. Multipurpose reservoir, flood prevention structures and recreation facilities			
		177,235	-			146,248	296,264
b. Recreation		374,031	20,000 <u>2/</u>	Project construction		14,582	56,958
c. Water supply		6,632	-	Project administration		55,137	25,620
d. Secondary		126,993	-	OM&R			
Total Beneficial Effects		684,891	20,000	Total Adverse Effects		105,967	378,842
				Net Beneficial Effects + 578,924 - 358,842			

1/ Amortized at 5 7/8 percent interest for 100 years.
2/ These benefits are those considered as outside the State of Indiana.

July 1975

SELECTED PLAN
ANDERSON RIVER WATERSHED
REGIONAL DEVELOPMENT ACCOUNT

<u>Components</u>		<u>Measures of Effects</u>		<u>Components</u>		<u>Measures of Effects</u>	
		Indiana Planning Region Number 13	Rest of Nation			Indiana Planning Region Number 13	Rest of Nation
B. Employment				B. Employment			
Beneficial effects				Adverse effects			
1. Increase in the number and types of jobs.				1. Decrease in number and type of jobs			
a. Agricultural employment		6 seasonal semi-skilled jobs	-	a. Agricultural employment		2 seasonal semi-skilled jobs	-
b. Employment Officer		2 permanent semi-skilled jobs and 8 seasonal semi-skilled jobs	-	b. Reduction in road and bridge damage		1 seasonal semi-skilled job	-
c. Employment for project construction		120 semi-skilled jobs for 1 year	-	Total adverse effects		3 seasonal semi-skilled jobs	-
Total beneficial effects		2 permanent semi-skilled jobs	-	Net beneficial effects		2 permanent semi-skilled jobs	-
		14 seasonal semi-skilled jobs	-			11 seasonal semi-skilled jobs	-
		120 semi-skilled jobs for 1 year	-			120 semi-skilled jobs for 1 year	-

SELECTED PLAN
ANDERSON RIVER WATERSHED
REGIONAL DEVELOPMENT ACCOUNT

<u>Components</u>	<u>Measures of Effects</u>	<u>Rest of Nation</u>
	<u>Indiana Planning Region Number 13</u>	
C. Population Distribution		
Beneficial effects	Created 2 permanent semi-skilled jobs, 11 seasonal semi-skilled jobs and 120 semi-skilled jobs for one year in a depressed rural area.	- - - -
Adverse effects	-	-
D. Regional Economic Base and Stability		
Beneficial effects	Creates 2 permanent semi-skilled jobs, 11 seasonal semi-skilled jobs, 120 man job years for project installation in a four county area with family income ranging from 6.7 to 18.1 percent below the poverty level.	- - - - - -

July 1975

SELECTED PLAN
ANDERSON RIVER WATERSHED
ENVIRONMENTAL QUALITY ACCOUNT

Components

Measures of Effects

Beneficial and Adverse Effects

A. Areas of Natural Beauty

1. Reduce annual erosion in the watershed from 553,892 tons to 427,566 tons per year. A 23 percent reduction.
2. Stabilize 71 acres having a critical erosion problem.
3. Create 623 acres of temporary water and 1,103 acres of permanent water in 46 single purpose floodwater retarding structures and 3 multiple purpose reservoirs.
4. Inundate approximately 12.1 miles of perennial streams and 8.5 miles of intermittent feeder streams.
5. Enhance physical appearance on 42,582 acres of agricultural lands by reducing sediment and debris deposition and flood plain scour.
6. Increased traffic flow due to the two recreational facilities with a combined estimated 175,125 recreation visits annually.
7. Increase aesthetic value of water in watershed streams by reducing sediment concentrations by 50 percent.

B. Quality Considerations of
Water, Land and Air
Resources

1. Reduce sediment concentrations in stream flows by 50 percent (23 percent by land treatment; 27 percent by reservoir sediment pools).
2. Increase dust, smoke, and exhaust fumes due to increased vehicular traffic from the potential 175,125 recreation visits annually.

July 1975

3. Increase stream capacity by removing debris blocks and hazardous trees on 10.5 miles of the main channel.
4. Create a major outdoor recreation industry complementing many of the area's scenic and historical points of interest.
5. Reduce average annual flood damages by 48 percent.
6. Reduce erosion on 42,582 acres of cropland, grassland, and forest land.
7. Reduce flood plain scour on 369 acres of flood plain soils now having a serious problem.
8. Increase erosion and sedimentation. air pollution, and noise pollution during the 10 year construction period.
9. Reduce the inflow of fertilizers, pesticides, and animal wastes into watershed streams.

C. Biological Resources and
Selected Ecosystems

1. Inundate approximately 12.1 miles of perennial stream fishery and 8.5 miles of intermittent feeder streams.
2. Create 1,103 acres of potential fish and other aquatic habitat.
3. Periodically create 623 acres of aquatic wildlife habitat in flood pool areas.
4. Sustain stream fishery below reservoir Nos. U-1 and U-10 through the release of cool, oxygenated water.
5. Increase the value of stream waters to wildlife and fish by a 50 percent reduction of sediment load.
6. Net increase of upland wildlife and recreation land of 1,811 acres.

July 1975

7. Increased benefits to upland wildlife by less intensive use of erosive cropland.
8. Temporary disruption of stream fishery in the 10.5 miles of channel to be cleared of debris and hazardous trees.
9. Temporary disruption of wildlife during construction.
10. Implementation of wildlife habitat management and development plans on 1,038 acres.
11. Create 170 farm ponds complementing pasture enterprises and enhancing fish and wildlife values.

D. Irreversible or
Irretrievable Commitments

1. Inundate 1,103 acres of cropland, pasture, and woodland, as well as 12.1 miles of perennial and 8.5 miles of intermittent streams in permanent pool areas.
2. Change land use of 278 acres of forest land, pastureland and cropland to dams and emergency spillways.

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SELECTED PLAN
ANDERSON RIVER WATERSHED
SOCIAL WELL BEING ACCOUNT

Components

Measures of effects

Beneficial and adverse effects:

- | | |
|-------------------------------|---|
| A. Real income distribution | 1. Create 2 permanent semi-skilled jobs and 11 seasonal semi-skilled permanent low to median income jobs for area residents |
| | 2. Estimated income range is \$7,000 to \$9,000 for permanent jobs and \$2,500 to \$5,000 for seasonal jobs. |
| B. Life, health and safety | 1. Provide water meeting state standards for an estimated 1,645 people at the Saint Meinrad Archabbey and industrial water for potential expanded employment at Birdseye. |
| C. Recreational opportunities | 1. Provide opportunities for 175,125 recreation visits for the local rural farm population and the more populous nearby areas. |

July 1975

24500 WATERSHED WORK PLAN,
ANDERSON RIVER WATERSHED,
(Crawford, Dubois, Perry and Spencer Counties, Indiana) 8/1

Prepared Under the Authority of the Watershed
Protection and Flood Prevention Act (Public
Law 566, 83d Congress, 68 Stat. 666) as
Amended

Prepared by

Crawford County Soil and Water Conservation District
Dubois County Soil and Water Conservation District
Perry County Soil and Water Conservation District
Spencer County Soil and Water Conservation District
Anderson River Conservancy District
Town of Birdseye

State of Indiana

Assisted by

U. S. Department of Agriculture, Soil Conservation Service
U. S. Department of Agriculture, Forest Service.

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PROJECT MAP

WATERSHED WORK PLAN AGREEMENT

between the

Dubois County Soil and Water Conservation District
Local Organization

Crawford County Soil and Water Conservation District
Local Organization

Perry County Soil and Water Conservation District
Local Organization

Spencer County Soil and Water Conservation District
Local Organization

Anderson River Conservancy District
Local Organization

Perry County Park and Recreation Board
Local Organization

Town of Birdseye, Dubois County
Local Organization

Indiana Department of Natural Resources, Division of Forestry
Local Organization

(hereinafter referred to as the Sponsoring Local Organizations)

State of Indiana

and the

Soil Conservation Service
United States Department of Agriculture

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Anderson River Watershed, State of Indiana, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended, and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service, and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Anderson River Watershed, State of Indiana, hereinafter referred to as the Watershed Work Plan, which Plan is annexed to and made a part of this agreement.

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the Watershed Work Plan, and further agree that the works of improvement, as set forth in said Plan can be installed in ten years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the Watershed Work Plan:

1. The Sponsoring Local Organization will acquire such land rights as will be needed in connection with the works of improvement. The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

		Perry Co.			Indiana Dept.	U.S.		
Works of	Anderson River	Park and	Town of	of Natural	Forest			Estimated
Improvement	<u>Cons. District</u>	<u>Rec.Board</u>	<u>Birdseye</u>	<u>Resources</u>	<u>Service</u>	<u>Service</u>	<u>Cost</u>	
	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Percent)	(Dollars)	
Floodwater Retarding Structures Nos. U-18 & U-38								
Use Permits on U.S. Forest Land	100	0	0	0	0	0	200	
Floodwater Retarding Structures Nos. U-8, U-28, U-29, U-35, L-6, L-13, U-4, & U-17								
Private Land (about 64 acres)	100	0	0	0	0	0	12,635	
State Forest Land (about 55 acres)	0	0	0	100	0	0	8,625	
Multiple Purpose Structure No. U-1								
Use Permits on U.S. Forest Land	50	0	50	0	0	0	200	
Cost of moving or modification of improvements	19.35	0	0.40	0	80.25	0	36,000	
Multiple Purpose Structure No. U-10 and Recreational Facilities								
Payment to landowners for about 430 acres	0	50	0	0	0	50	139,200	
Cost of moving or modification of improvements	0	50	0	0	0	50	23,000	
Legal fees, survey costs, flowage easements and other	0	100	0	0	0	0	17,000	
All other Structural Measures	100	0	0	0	0	0	244,450	

The Department of Natural Resources' sole purpose in becoming a local sponsoring organization is to provide approximately 55 acres of land rights on Ferdinand State Forest for the construction of Structures U-8, U-28, U-29, U-35, L-6, L-13, U-4 and U-17.

The Sponsoring Local Organization agrees that all land acquired or improved with P.L. 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operations and Maintenance Agreement.

2. The Sponsoring Local Organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organization and the Service as follows:

	<u>Sponsoring Local Organization</u> (Percent)	<u>Service</u> (Percent)	<u>Estimated Relocation Payment Costs</u> (Dollars)
Relocation Payments	58.13	41.87	21,500

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

<u>Works of Improvement</u>	<u>Anderson River Cons. District</u> (Percent)	<u>Perry Co. Park and Rec. Board</u> (Percent)	<u>Town of Birdseye</u> (Percent)	<u>Indiana Dept. of Natural Resources</u> (Percent)	<u>U.S. Forest Service</u> (Percent)	<u>Service</u> (Percent)	<u>Estimated Cost</u> (Dollars)
Multiple Purpose Structure No. U-1	0	0	0.40	0	80.25	19.35	1,301,545
Recreational Facilities	0	0	0	0	100	0	821,000
M & I Water Outlet Facilities	0	0	100	0	0	0	2,000
Multiple Purpose Structure No. U-10	0	39.11	0	0	0	60.89	365,185
Recreational Facilities	0	50	0	0	0	50	536,850
Multiple Purpose Structure No. L-24	29.41	0	0	0	0	70.59	58,811
M & I Water Outlet Facilities	100	0	0	0	0	0	12,000
All Single Purpose Floodwater Retarding Structures	0	0	0	0	0	100	1,645,401
Single Purpose Flood Prevention Channel Work	0	0	0	0	0	100	33,753

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Anderson River Cons. District</u> (Percent)	<u>Perry Co. Park and Rec. Board</u> (Percent)	<u>Town of Birdseye</u> (Percent)	<u>Indiana Dept. of Natural Resources</u> (Percent)	<u>U.S. Forest Service</u> (Percent)	<u>Service</u> (Percent)	<u>Estimated Cost</u> (Dollars)
Multiple Purpose Structure No. U-1	0	0	0.40	0	80.25	19.35	156,185
Recreational Facilities	0	0	0	0	100	0	82,100
M & I Water Outlet Facilities (A&E contract)	0	0	100	0	0	0	400
Multiple Purpose Structure No. U-10	0	0	0	0	0	100	43,820
Recreational Facilities (A&E contract)	0	50	0	0	0	50	37,800
Multiple Purpose Structure No. L-24	29.41	0	0	0	0	70.59	7,060
M & I Water Outlet Facilities	100	0	0	0	0	0	2,000
All Single Purpose Floodwater Retarding Structures	0	0	0	0	0	100	197,448
Single Purpose Flood Prevention Channel Work	0	0	0	0	0	100	4,050

6. The Sponsoring Local Organizations, the Service and the U.S. Forest Service will each bear the costs of project administration which they incur, estimated to be \$77,717, \$802,015 and \$164,200 respectively.
7. The Crawford, Dubois, Perry, and Spencer County Soil and Water Conservation Districts will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm plans on their land.
8. The Crawford, Dubois, Perry and Spencer County Soil and Water Conservation Districts will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the Watershed Work Plan.
9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of all structural works of improvement, except for structure No. U-1 and its associated recreational facility, by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction.

Structure No. U-1 and its associated recreational facility will be operated and maintained by the United States Forest Service. The Anderson River Conservancy District and the town of Birdseye will through agreement with the Forest Service participate in the operation and maintenance of structure U-1. Participation by the District and the Town will be based on the respective ratios of structure U-1 flood prevention costs and municipal and industrial water supply costs to total structure costs.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriations for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto, except that an amendment to incorporate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsor or sponsors having specific responsibilities for the particular structural measure involved.
14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1 - 15.12) which provide that no person in the United States shall, on the grounds of race, color, national origin, sex or religion, be excluded from participation in, be denied the benefit of, or be subjected to discrimination under any activity receiving Federal financial assistance.
16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

DUBOIS COUNTY SOIL AND WATER
CONSERVATION DISTRICT

Local Organization

By

Title

Address

Zip Code

Date

The signing of this agreement was authorized by a resolution of the governing body of the

Local Organization

adopted at a meeting held on

Secretary, Local Organization

Address

Zip Code

Date

CRAWFORD COUNTY SOIL AND WATER
CONSERVATION DISTRICT

Local Organization

By

Title

Address

Zip Code

Date

The signing of this agreement was authorized by a resolution of the governing body of the

Local Organization

adopted at a meeting held on

Secretary, Local Organization

Address

Zip Code

Date

PERRY COUNTY SOIL AND WATER
CONSERVATION DISTRICT

Local Organization

By

Title

Address

Zip Code

Date

The signing of this agreement was authorized by a resolution of the governing body of the

Local Organization

adopted at a meeting held on

Secretary, Local Organization

Address

Zip Code

Date

SPENCER COUNTY SOIL AND WATER
CONSERVATION DISTRICT

Local Organization

By

Title

Address

Zip Code

Date

The signing of this agreement was authorized by a resolution of the governing body of the

Local Organization

adopted at a meeting held on

Secretary, Local Organization

Address

Zip Code

Date

ANDERSON RIVER CONSERVANCY
DISTRICT

Local Organization

By _____

Title _____

Address _____ Zip Code _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the

Local Organization

adopted at a meeting held on _____

Secretary, Local Organization

Address _____ Zip Code _____

Date _____

PERRY COUNTY PARK AND RECREATION
BOARD

Local Organization

By _____

Title _____

Address _____ Zip Code _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the

Local Organization

adopted at a meeting held on _____

Secretary, Local Organization

Address _____ Zip Code _____

Date _____

TOWN BOARD OF THE TOWN OF BIRDSEYE
Local Organization

By _____

Title _____

Address _____ Zip Code _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the

Local Organization

adopted at a meeting held on _____

Secretary, Local Organization

Address _____

Date _____

STATE OF INDIANA

This instrument approved as to legality and
form this _____ day of _____,
1975.

INDIANA DEPARTMENT OF NATURAL RESOURCES

By _____

Title _____

Address _____

Date _____

Attorney General

Approved:

Otis R. Bowen, M.D., Governor

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

State Conservationist

Date

SUMMARY OF THE PLAN

The Anderson River Watershed occupies an area of 97,174 acres or approximately 152 square miles in southcentral Indiana. (1) Anderson River, the principal watershed drainage, rises in the sloping uplands of southwestern Crawford County and flows first to the southwest and then to the south approximately 45 miles where it outlets into the Ohio River. Some six miles north of its outlet, it is joined by the Middle Fork of the Anderson River, a P.L. 566 project of 69,400 acres already under construction.

Portions of four counties (Crawford, Dubois, Perry and Spencer) are contained within the watershed. Three of these counties (Crawford, Perry and Spencer) lie within the Lincoln Hills Resource Conservation and Development project. Crawford County lies within an area designated under the Economic Development Act as a depressed area.

Approximately 10,290 acres of publicly owned forest land lie within the watershed boundaries. Six thousand four hundred and seventy acres (6,470) of this total are located in the Ferdinand State Forest which is administered by the Indiana Department of Natural Resources, Division of Forestry. The remainder (3,820 acres) is a part of the Hoosier National Forest and is administered by the U.S. Forest Service. National forest landholdings are expected to increase throughout the life of the project.

Major soil and water resource problems and development needs in the watershed include watershed protection, flood prevention, public recreation and municipal and industrial water supply. Nearly two-thirds of watershed soil resources are handicapped by low inherent fertility and severe erosion hazards. Flooding affects an estimated 8,064 acres inflicting damage to crops, pasture, other agricultural values, roads and bridges. These problems together with the needs for additional municipal water at the Saint Meinrad Archabbey, industrial water at the Town of Birdseye, and public recreation in the general region, provided the basis for project formulation.

The project sponsors are the Crawford, Dubois, Perry and Spencer County Soil and Water Conservation Districts, the Anderson River Conservancy District, the Perry County Park and Recreation Board, the Town of Birdseye, and the Indiana Department of Natural Resources, Division of Forestry. Such sponsors have developed a comprehensive program of accelerated land treatment and structural measures to be installed over a ten year period for the solution of water problems and satisfaction of resource development needs.

Land treatment practices and measures to be applied will emphasize tree planting, pasture planting, pasture and hayland management, farm ponds, minimum tillage, diversions and grassed waterways. Total cost of planned land treatment measures is \$2,999,403, of which \$620,400 is for technical assistance and \$2,379,003 is for installation. Public Law 566 cost is \$400,000 and will be used for accelerated technical assistance. The Other cost (all funds other than P.L. 566) for land treatment measures is \$2,599,403, of which \$220,400 is for Soil Conservation Service and Forest Service technical assistance under the going programs, \$900 is for installation of land treatment measures on

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-Summary-

Hoosier National Forest land and \$2,378,103 is for installation of land treatment measures on private land.

Local landowners and farm operators working through the sponsoring Soil and Water Conservation Districts will assume responsibility for installation, operation and maintenance of land treatment measures on areas of private ownership. Such responsibilities on Hoosier National Forest land will be borne by the U.S. Forest Service.

Proposed structural measures include 46 single purpose floodwater retarding structures, 1 multiple purpose structure for flood prevention, public recreation and industrial water supply, 1 multiple purpose structure for flood prevention and municipal water supply, 1 multiple purpose structure for flood prevention and recreation, 2 recreational developments and 10.5 miles of channel work. (See Project Map). Total estimated cost of the proposed measures is \$6,854,150, of which \$3,725,882 is P.L. 566 cost and \$3,128,268 is Other cost. (Table 1). Average annual operation and maintenance costs for structural measures is estimated at \$80,757, of which \$72,392 is for operation, maintenance and replacement of the recreational facilities. (Table 4).

The Anderson River Conservancy District will assume responsibility for installation, operation, maintenance and administration of construction contracts for all structural measures except structure Nos. U-1 and U-10 and their associated recreational developments. The Conservancy District will consummate a memorandum of understanding with the Saint Meinrad Archabbey regarding installation, operation and maintenance of the municipal water supply portion of structure No. L-24. Responsibility for installation, operation, maintenance and administration of construction contracts for structure No. U-10 and its associated recreational development will be borne by the Perry County Park and Recreation Board.

The construction contract for structure No. U-1 will be administered by the Soil Conservation Service. The contract for its associated recreational development will be administered by the Forest Service. The installation of structure No. U-1 will be the joint responsibility of the Forest Service, the Conservancy District and the Town of Birdseye. Installation of the U-1 recreational facility will be the responsibility of the Forest Service. By agreement between the Soil Conservation Service and the Forest Service, the Forest Service will be responsible for operation and maintenance of both the structure and its associated recreational facility. The Forest Service will consummate a memorandum of understanding or similar document with the Conservancy District regarding operation and maintenance of structure No. U-1 for flood prevention purposes, and with the Town of Birdseye for the purpose of industrial water supply.

The proposed land treatment measures will reduce watershed erosion from an annual rate of 5.7 tons per acre to 4.4 tons, a 23 percent reduction. Sedi-ment concentrations in watershed stream flows will be reduced an average of 50 percent by all project measures, whereas overall flood damages will be reduced in monetary equivalents by an average of 48 percent. The project will in addition cause a number of land use changes, a summary of which is as follows.

			WITH PROJECT <u>1/</u>		
Land Use	Current Acres	After With- out Project Land Treat- ment (Ac.)	After Accel- erated Land Treatment Application (Ac.)	After Struc- tural Mea- sure Instal- lation (Ac.)	After Flood Plain Land Use Conver- sion (Ac.)
Cropland	26,241	23,229	18,576	18,152	18,372
Pastureland	22,901	26,050	30,913	30,703	30,628
Forest Land	38,622	39,399	40,600	39,711	39,566
Open <u>2/</u> Water	80	80	80	1,183	1,183
Other Wildlife & Land Recreation	1,052	1,705	2,715	2,863	2,863
Idle and <u>3/</u> Miscellaneous	8,278	6,711	4,290	4,562	4,562
Watershed Total	97,174	97,174	97,174	97,174	97,174

1/ Project effects are cumulative from left to right.

2/ Includes areas greater than 2 acres, does not include streams.

3/ Includes farmsteads, roads, urban areas, strip mines, etc.

The proposed recreation lakes of 654 acres and 152 acres together with their associated recreational developments will provide opportunities for a total of 175,125 recreation visits annually. Municipal water supply needs at the Saint Meinrad Archabbey and industrial needs at the Town of Birdseye will be met by storage of 120 and 100 acre-feet of water, respectively.

Project structural measures will displace 2 owner occupied dwellings and 1 farm operation. A total of 12.1 miles of perennial streams and 8.5 miles of intermittent streams will be permanently inundated by structure permanent pools. Planned channel work will result in the removal of 80 trees and 5 flow obstructing, debris blockages.

Average annual benefits to project structural measures are estimated at \$704,891. Comparison of this benefit to average annual costs of \$484,809 yields a project benefit-cost ratio of 1.5 to 1.0 (Table 6).

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Physical Data

The project is located in Crawford, Dubois, Spencer and Perry Counties in southcentral Indiana and has an area of 97,174 acres or 152 square miles. Approximately 13 percent of the project is in Crawford County, 19 percent in Dubois County, 25 percent in Spencer County and 43 percent in Perry County.(1)

The Watershed is approximately 25 miles long and averages about 8 miles in width. Anderson River rises in the rolling uplands in the northern portion of the watershed and flows in a general southerly direction to its outlet in the Ohio River at Troy, Indiana. The watershed is a part of the Evansville-Green Subregion of the Ohio Region as classified by the United States Water Resources Council. (2) This subregion includes parts of southern Indiana, central Kentucky, and northcentral Tennessee. This subregion is a transitional zone between the topographically flat to rolling glaciated subregions to the north and the mountainous subregions to the south and east. The water resources within the watershed are similar to that in other watersheds in the westcentral portion of the subregion.

Evansville, Indiana, to the southwest, Terre Haute, Indiana, to the northwest, and Louisville, Kentucky, to the east are the largest urban centers within 100 miles of the watershed. Other metropolitan areas within 200 miles include Indianapolis, Indiana; Cincinnati, Ohio, and Lexington, Kentucky. These centers are easily accessible and provide markets for manufactured products produced in the watershed.

Approximately two-thirds of all watershed soils have very severe erosion potential. An estimated 8,700 acres of these lands are under some form of cultivation. The most serious erosion problems exist in the steep uplands. Four hundred acres of critically eroded land (rill and gully erosion) exist in upland areas of the watershed. Flood plain scour is a problem on 369 acres of flood plain soils. Potential floodwater damage affects 8,064 acres of land in the flood plain of the Anderson River. Drainage is a problem on approximately 5,650 acres of flood plain soils and 1,150 acres of terrace soils. Approximately 70 percent of these soils are used as cropland.

The central and eastern portions of the watershed lie within the most rugged of Indiana's geomorphic provinces, the Crawford Upland. Topography in these areas consists of great subangular ridges, steep narrow upland valleys, and well developed major flood plains. The western portion of the watershed lies within a transition zone between the Crawford Upland and the Wabash Lowland, and is characterized by moderately steep topography with rounded ridges and well developed flood plains. (3) Elevations range from approximately 850 feet mean sea level near the northern boundary to 350 feet at the outlet creating a total relief of 500 feet.

Mean temperatures in the watershed range from 78 degrees Fahrenheit in July to 35.3 degrees in January. The recorded extremes are 12 degrees below zero and 105 degrees above. The average date of the last spring freeze is April 29 and that of the first fall freeze is October 26. The average frost free growing season is 200 days. The mean annual precipitation is 45.2 inches with extremes of 28.8 and 73.9 inches. The more intense rains generally fall during

May and June. (4) (5)

Soils in the watershed are grouped into four associations, the major one being the Gilpin-Berks. Soils in this association are on upland side slopes and are formed in sandstone. They are moderately deep, well drained and strongly sloping to steep. The second major grouping is the Cuba-Haymond association. Soils in this association are deep and well drained and are nearly level. They are formed in medium textured alluvium and are on bottom land areas and low terraces. Soils in the Zanesville-Tilsit association are on upland ridge tops and are deep and moderately well to well drained. They are gently to moderately sloping and are formed in loess over sandstone. Soils in the Markland-McGary association are on terraces near the mouth of the Anderson River and are formed in fine textured lakebed materials. They are deep, well to somewhat poorly drained and are nearly level.

Land unit capabilities of bottomland soils range typically between I and II. (6) Land unit capabilities of terrace soils range typically between II and IV. Land unit capabilities of ridge top soils and steep upland soils range typically from II to VI and VI to VII respectively.

The area is underlain by the Stephensonport and the Raccoon Creek bedrock Groups. The Stephensonport Group consist of interlayered sandstone, limestone and shale. Sandstone and shale are the predominant rock types. The Raccoon Creek Group is predominantly sandstone with minor beds of limestone, shale and coal. Petroleum and gas are produced in the central part of the watershed, although operations are not extensive. Many wells have been abandoned due to low productivity, and those that are still active are shallow (less than 2,000 feet) and produce oil and gas in relatively small quantities. (7) Oil and gas exploration activities in southern Indiana are on the increase. At least two significant discoveries have been made recently in Spencer County. Past and present production within the watershed will undoubtedly encourage renewed production there.

Most of Perry County's recoverable reserves of coal lie within the watershed. The U.S.D.I. Bureau of Mines reports that these reserves amount to over 10.1 million tons of coal obtainable by underground mining. Coal is also present in the Crawford, Spencer and Dubois County portions of the watershed.

Sandstone is quarried locally for domestic building purposes, but the low quality of the stone limits its potential as a marketable product. (1)

Ground water supplies are limited for use throughout all but the lower portions of the watershed. These supplies must generally be supplemented by surface water. Aquifers present within most of the watershed are limited to relatively dense sandstones and minor limestones which are both slow to moderately permeable. Ohio River sediments bordering the southern extremity of the watershed contain vast quantities of easily recoverable ground water. (8)

Present land use in the watershed and the flood plain area is estimated as follows: (1)

Land Use	Acres		Percent	
	Watershed	Flood Plain	Watershed	Flood Plain
Cropland	26,241	6,372	27	79
Pastureland	22,901	351	24	4
Forest Land	38,622	1,036	40	13
Other Land	9,410	305	9	4
TOTAL	97,174	8,064	100	100

Flood plain land with adequate drainage is predominantly used for continuous row cropping (corn and soybeans) and for row crop-small grain (wheat) rotations. Those flood plain areas with drainage problems are mainly in grass (bluegrass, fescue and orchardgrass) and are managed as pastureland. Small tracts of forest land exist within the flood plain in areas where drainage problems exist or where access by farm machinery is difficult.

Upland cropland is limited to hillside benches formed by weathering and erosion of shale formations, the flatter ridgetops, and to gently sloping hillsides. Crop rotations are typically one season of corn followed by a season of wheat followed by three years of pasture. Upland acreages utilized for continuous pasture are predominantly cleared grassed areas on moderate to steep slopes that cannot be economically cropped because of serious soil erosion hazards. Approximately 8,300 acres of land, mostly in the upland areas, are used periodically beyond their capability and become subject to severe erosion losses. Approximately 400 acres of upland soils in scattered small tracts have been used continuously beyond their capability resulting in critical rill and gully erosion. In summary, the most common improper uses of the erosion prone upland soils are the frequent cultivation of row crops and small grains and the practice of over grazing of cattle on pastureland.

Most of the forest land in the watershed is found on the steep upland slopes. Much of the forest land and some areas of idle land are slowly undergoing a successional change in plant species. Most of these areas are in sub-climax stage where oak-hickory are the dominant species. Left undisturbed, beech-maple climax forests will ultimately emerge.

Percent of forest land area in the watershed by timber type. (9)

<u>Timber Type</u>	<u>Percent</u>
Loblolly - Shortleaf pine	2
Oak - Pine	3
Oak - Hickory	71
Oak - Gum - Cypress	<1
Elm - Ash - Cottonwood	6
Maple - Beech - Birch	18

Percent of forest land area in the watershed by Stand Size and Timber Type. (9)

	Stand Size Class	Loblolly Shortleaf pine	Oak Pine	Oak Hickory	Oak Gum Cy- press	Elm Ash Cotton- wood	Maple Beech Birch
Saw Timber Stand	51	14	16	49	79	68	63
Pole Timber Stand	24	45	36	25	9	18	20
Seedling and Sapling Stand	25	41	48	26	12	10	16
Non-Stocking	<1	-	-	-	-	4	1

All streams within the watershed can be classified as unmodified, well defined natural channels of streams except for about two miles, a one mile section on the main channel in reach 6 and a one mile section on Hurrican Creek in reach 21. (1) These sections have been modified previously by channel excavation. (See Project Map).

There are approximately 116 miles of perennial streams in the watershed (streams which flow at all times except during extreme drought). Perennial streams include the main branch of the Anderson River and the middle and lower reaches of all named major tributaries. Approximately 206 miles of intermittent streams (streams with continuous flow through some seasons of the year but little or no flow through other seasons) exist within the watershed. (1) Intermittent streams include the upper reaches of named tributaries to Anderson River and the major tributaries to these streams which flow across definable flood plains. Many ephemeral streams (streams which flow only during periods of surface runoff) exist in the well defined steep narrow drainageways tributary to intermittent streams. Ephemeral streams lack a definable flood plain and normally flow on bedrock. The great density of ephemeral streams precludes accurate measurement of their total length.

The main branch of the Anderson River begins at the rugged extreme northern portion of the watershed as a narrow rocky channel flowing in a wooded, steep valley. Two and one-half miles downstream, a flood plain widens to nearly a quarter of a mile near the confluence with Mitchel Creek. Proceeding downstream, the flood plain has a fairly constant width but the channel becomes wider and deeper with increasing flow from numerous tributaries. The stream meanders across the flood plain repeatedly, occasionally contacting the valley walls exposing sections of massive sandstone bedrock. At the junction with Sigler Creek the flood plain is nearly one-half mile wide between steep wooded uplands. The width remains constant through the mid reaches of the watershed. The channel gradually increases to approximately 25 feet in width and to approximately 10 feet in depth in the vicinity of Saint Meinrad. Steep sided, tree-lined banks with minor cycles of riffle and pool development characterize the middle and lower reaches. Approximately two miles below Saint Meinrad the flood plain narrows appreciably. In the lower reaches the river becomes more sluggish and is bordered by increasing numbers of woodlots. Below the confluence of the Middle Fork, Anderson River averages over 100 feet in width and fifteen feet in depth. The Anderson River enters the Ohio River about one-half mile west of Troy, Indiana.

-Setting-

Water for the Archabbey at Saint Meinrad is provided from two small reservoirs with surface areas of approximately five acres each. A State-owned 40 acre lake in the Ferdinand State Forest provides some public recreation and a dependable source of water to the fish hatchery located immediately downstream.

A small private recreation development adjoins the Spencer County Memorial Forest lake in the southern part of the watershed. Facilities provide for picnicking, camping and fishing.

Results of a surface water sampling and testing program conducted by U.S. Geological Survey indicate a generally good quality of water within the basin. A few water quality problems, in certain isolated areas, were identified. These are related to abandoned strip mining operations, agricultural chemical runoff, and ineffective septic systems in isolated areas. These water quality problems are further discussed in the Problems and Investigation and Analyses sections.

Present and Projected Populations

Census data for 1960 and 1970 shows that the four counties encompassing the watershed are experiencing a slower rate of population growth than the State average. The following table offers a comparison of each individual county to the State total. Growth percentages shown for Dubois, Perry and Spencer Counties are influenced primarily by population increases outside the watershed area.

<u>Area</u>	<u>Population</u>		<u>Change</u>	
	<u>1960</u>	<u>1970</u>	<u>Number</u>	<u>Percent</u>
Crawford County	8,379	8,033	-346	-4.1
Dubois County	27,463	30,934	3,471	12.6
Perry County	17,232	19,075	1,843	10.7
Spencer County	16,074	17,134	1,060	6.6
Indiana	4,662,498	5,193,669	531,201	11.4

(10)

Median age of the population is 32.1 years for Crawford County, 25.0 for Dubois County, 27.5 for Perry County, 28.8 for Spencer County, and 27.2 for the State of Indiana. (11)

Economic Resources

Watershed land is predominantly in private ownership with the exception of 10,290 acres of public forest land holdings. Approximately 6,470 acres are located within the Ferdinand State Forest which is administered by the Indiana Department of Natural Resources, Division of Forestry. The Hoosier National Forest Proclamation Boundary includes approximately 12,300 acres of watershed land, of which 3,820 acres are currently in public ownership. These areas are administered by the U.S. Forest Service, which is currently involved in an active land acquisition program.

Eight hundred farms are located wholly or partially within the watershed and are primarily of the family farm type. The average farm is 120 acres in size and averages about \$36,000 in value. Upland cropland is valued at \$150 to \$450 per acre, flood plain cropland at \$450 to \$900 per acre and forest land at \$75 to \$300 per acre.

The watershed is primarily an agricultural area with livestock, livestock products and cash grain comprising the major agricultural enterprises. Major crops grown in the flood plain are corn and soybeans with average yields over the past several years of 60 bushels per acre for corn and 20 bushels for soybeans. Crops grown on upland areas are about evenly divided between row crops, small grain and meadow. Forest land areas are moderately to well stocked with mixed central hardwood types predominating.

Towns and villages within or on the watershed boundary are Birdseye (population 366), Saint Meinrad (population 700), Troy (population 537) and New Boston (population 50). These local communities together with the larger towns of Jasper, 15 miles to the north of the watershed; Tell City, 4 miles to the south; Evansville, 48 miles to the west; and Louisville, Kentucky, 64 miles to the east, serve as principal center of economic, social and cultural activity for watershed residents. Present population within a 25 mile radius of the watershed is estimated at 80,000 and over one-half million people live within a 50 mile radius.

Markets for watershed agricultural products are generally adequate and are supplied through local grain elevators, livestock auctions and slaughter facilities and regional outlets outside the watershed. Local markets for quality sawlogs, veneer logs, stave material, pallet material and pulpwood are good.

U. S. Highway No. 460 and State Road No. 62 cross the area in an east-west direction. These roads are located in the northcentral portion of the area in a north-south direction. State Road No. 545 runs along the watershed's western boundary. State Road No. 64 follows the northern boundary, and State Road No. 66 crosses near the watershed's outlet into the Ohio River. These highways together with a well developed system of county roads provide easy access to all parts of the watershed. Southern Railway branch lines cross the northern and southern parts of the watershed. They generally run in an east-west direction.

Interstate Highway No. 64, currently under construction, will cross through the middle of the watershed. It will provide direct routes to Evansville, Indiana, and Louisville, Kentucky. A new bridge over the Ohio River at Cannelton has also facilitated traffic flow.

Many watershed farms are low income producing units with an estimated 60 percent having gross sales of less than \$5,000 per year. The average market value per farm of all agricultural products sold in 1969 was \$5,685 in Crawford County, \$23,578 in Dubois County, \$6,152 in Perry County, \$11,485 in Spencer County, and \$13,797 for the State of Indiana. Seventy percent of watershed farmers have off-farm income. (12)

Farm products sales are derived approximately 80 percent from livestock and livestock products and 20 percent from crops. Forest products account for but one percent of farm product sales.

Characteristics of farm operators in the four watershed counties and the State of Indiana for the year 1969 are shown in the following table. (12)

<u>Characteristics</u>	<u>Crawford County</u>	<u>Dubois County</u>	<u>Perry County</u>	<u>Spencer County</u>	<u>State of Indiana</u>
No. Operators	543	1,180	583	1,136	-
No. Full Owners	482	891	470	736	-
No. Part Owners	52	213	83	301	-
No. Tenants	9	75	30	99	-
Percent Tenancy	1.6	6.4	5.1	8.7	12.1
Average Age	52.0	48.0	50.7	50.2	49.8

Per capita and median family incomes for the four counties are lower than the State average. Except for Dubois County, all the counties have a higher percentage of families with income below the poverty level than the State average. The following table reflects the income and poverty status of watershed counties in comparison to the State of Indiana.

<u>Area</u>	<u>Per Capita Income (Dollars)</u>	<u>Median Family Income (Dollars)</u>	<u>Percent of Families With Income Below Poverty Level</u>
Crawford County	2,220	6,655	18.1
Dubois County	2,641	9,011	6.7
Perry County	2,346	7,989	13.2
Spencer County	2,303	7,785	15.2
Indiana	3,093	9,970	7.4

(13)

A high percentage of the watershed work force is employed outside of the watershed area. Manufacturing and retail trade enterprises located in nearby cities offer the greatest employment opportunities. Agricultural and construction rank third and fourth as major areas of employment. Major types of employment for the four counties are manufacturing - 41 percent, retail trade - 13 percent, agriculture - 9 percent, construction - 8 percent, and all other - 29 percent. (13)

Annual unemployment averages for 1970 as determined by the Indiana Employment Security Division were 13.2 percent in Crawford County, 3.4 percent in Dubois County, and 5.6 percent in Perry County. (14) Information was not available on unemployment rates for Spencer County. Indiana unemployment rate for 1970 was 4.8 percent and was 4.9 percent for the United States. (15)

The entire watershed area is located within either the Lincoln Hills or the Four Rivers Resource Conservation and Development Project areas. The Crawford County portion of the watershed lies within a designated economic development area under the Economic Development Act.

Plant and Animal Resources

The Anderson River provides a significant sport fishery from its confluence with the Ohio River upstream for approximately seven miles. Upstream reaches serve primarily as spawning and nursery areas. The Indiana Division of Fish and Wildlife has developed a public fishing access site with a boat launching ramp at the State Road 545 bridge across Anderson River about 1.5 miles upstream of its outlet in the Ohio River. Use by fishermen is evident at this and most other points of easy access along the lower portion of the main stem.

Fish sampling studies were conducted by the Indiana Department of Natural Resources, Division of Fish and Wildlife, to determine species composition and distribution in the Anderson River. Based on weight, game fish species were found to compose approximately twenty-five percent of the total fishing in the lower reaches. Game species present in these areas included channel catfish, largemouth bass, spotted bass, freshwater drum, white crappies, sunfishes, and bullheads. (16)

In addition, many important species of forage fish were found throughout the watershed stream system. Reproduction of forage fishes (bluntnose minnow, common shiner, creekchub, etc.) contribute to the food supply required by the game fishes in Anderson River as well as the Ohio River. Water quality within watershed streams is not a limiting factor to species growth of reproduction.

Other fishery resources in the watershed include a 40 acre lake within the Ferdinand State Forest in the westcentral portion of the watershed, two small water supply reservoirs for the Saint Meinrad Archabbey in the central portion, and a number of scattered small farm ponds. The lake within the State Forest has public access and supports moderate populations of bluegill, crappie, bass, bullheads, and carp. All other impoundments are private and are stocked primarily with bass and bluegill.

Wildlife numbers and species throughout the watershed are influenced by the high percentage of woodlands and mixture of different habitat types such as cropland, grassland, and forest land. Wildlife populations are considered good. Deep forest dwelling species include gray squirrel, gray fox, and number of small mammals such as chipmunks, mice and moles, and a variety of woodpeckers. Principal edge and small woodlot dwelling species include the cottontail rabbit, fox squirrel, woodchuck, bobwhite quail, and a large variety of raptors and songbirds. Whitetail deer, red fox, and raccoon are found associated with both edge and small woodlot habitat and with large tracts of deep forest habitat.

Squirrels and rabbits are the most abundant game animals and receive two-thirds of all hunting pressure. Quail hunting also occurs and ranks third in popularity. Both fox and raccoon are numerous and afford many hours of hunting and chasing. The deer population in the watershed is below the natural carrying capacity of the available habitat mainly as a result of heavy poaching pressure. (17) Muskrat is the most popular quarry of trappers because of their relative abundance near farm ponds and streams. Mink are sometimes taken but are not very plentiful in this area.

Public hunting is limited to access points along Anderson River, land within the Hoosier National Forest, and Ferdinand State Forest lands.

Waterfowl in the area are primarily limited to wood ducks. The lower main stem of Anderson River and some upstream reaches serve as important nesting and brooding grounds.

No rare and endangered species are known to exist within the Anderson River Watershed.

Recreational Resources

Existing public recreational resources in the watershed include the previously

-Setting-

mentioned 40 acre lake in the Ferdinand State Forest in section 18, T35, R3W, and the Anderson River access site at State Road 545 bridge. A public recreation facility adjoins the State Forest lake and is operated and maintained by the Indiana Department of Natural Resources, Division of Forestry. Facilities are provided at this location for camping, swimming, picnicking, hiking, boating, fishing and hunting. The design capacity of the recreational facility is 600 people. This facility is fully utilized during the 14 week summer recreation season, and estimates are that 25,000 to 30,000 people use the facility each year.

Other public recreational resources in the watershed include state and national forest lands which are available for hiking, nature observation and hunting.

A small private recreation development adjoins the Spencer County Memorial Forest lake in the southwestern part of the watershed. Facilities provide for picnicking, camping and fishing. Approximately 1,000 recreation visits have been recorded annually.

Another PL-566 project on the adjacent Middle Fork of Anderson River Watershed to the east is providing recreational opportunities at four of the six completed structures. These 4 structures are multiple purpose for flood prevention and recreation and provide 485 acres of surface water as a base for water-oriented recreation. Land area adjacent to the water is being developed by the U.S. Forest Service for various uses such as picnicking, camping, and hiking. The water areas are being used for boating (no gas motors), fishing, and swimming.

The wooded uplands of the watershed are suited for recreational development because of their land forms and vegetation. The uplands generally lack areas of permanent water for outdoor water based recreation but do have numerous sites for lake development. Upland soils with slopes less than 12 percent have moderate limitations for recreational facility development, and those soils with slopes greater than 12 percent have severe limitations. Flood plain areas lack the natural beauty of the uplands and are generally best suited for long term agricultural use. Flood plain soils have severe limitations for developing permanent recreation facilities.

Archeological, Historical and Unique Scenic Resources

The Glenn A. Black Laboratory, Bloomington, Indiana provided information concerning known sites of archeological interest within the watershed. Such sites are limited to scattered areas where chipped stone remnants identify the location of past Indian activity. Natural rock shelters once used by Indians can also be observed along sandstone escarpments in the northern and western portions of the watershed. (18)

The National Register of Historic Places list no features of historical significance within the watershed. County historical societies report several pioneer cemeteries scattered throughout the area and the possible remains of a grist mill adjacent Mitchel Creek in the northern part of the watershed. An intensive field investigation failed to locate any remains of this grist mill.

Soil, Water and Plant Management Status

Recent land use statistics for the watershed are shown in the table below. Land in farms is on the decline, as is the amount of land in intensive agricultural use.

Expansion of Hoosier National Forest represents a significant factor in the decline of land in farms for Crawford and Perry Counties. County and total land acreage differences between 1964 and 1969 reflect the acreage of lakes and farm ponds constructed in this period.

<u>Item</u>	<u>Year</u>	<u>Crawford County</u>	<u>Dubois County</u>	<u>Perry County</u>	<u>Spencer County</u>	<u>Total</u>
Approximate land	1964	199,685	277,125	245,765	253,445	976,020
Area - acres	1969	199,680	276,992	245,760	253,440	975,872
Land in farms -	1964	107,075	219,255	137,745	200,755	664,830
acres	1969	85,660	214,849	99,282	203,065	602,856
Percent in farms	1964	53.6	79.1	56.0	79.2	68.1
	1969	42.9	77.6	40.4	80.1	61.8
Total in cropland -	1964	44,727	142,032	62,466	143,509	392,734
acres	1969	39,933	139,780	50,982	149,497	380,192
Harvested	1964	17,705	87,543	31,651	100,775	237,674
Cropland - acres	1969	12,215	82,563	24,466	97,262	216,506
Cropland used only						
for pasture or	1964	15,000	27,132	14,464	20,443	77,039
grazing - acres	1969	15,838	30,114	14,461	27,600	88,013
All other crop-	1964	12,022	27,357	16,351	22,291	78,021
land - acres	1969	11,880	27,103	12,055	24,635	75,673
Woodland including						
Woodland pasture -	1964	44,803	53,352	54,334	28,010	180,499
acres	1969	30,081	47,847	36,707	31,757	146,392
All other land -	1964	17,534	23,860	20,942	29,225	91,561
Acres	1969	15,646	27,222	11,593	21,811	76,272

(19)

Labor and capital resources are generally underinvested in the crop production process on watershed flood plain soils and in pasture and forestry enterprises throughout the area. Intensive agricultural use is practiced on approximately 8,700 acres of marginal upland which has severe erosion hazards.

The importance of land treatment is recognized by the Soil and Water Conservation Districts involved within the watershed area and by the several public land administering agencies with watershed holdings.

Primary emphasis of the Soil and Water Conservation Districts has been to assist in the development and implementation of complete conservation plans on private land. Plans emphasize tree planting and management, pond construction, and installation of sediment and erosion control measures such as grade stabilization structures, diversions and grassed waterways. Conservation measures receiving emphasis on publicly administered land include tree planting, woodland grazing control and fire control.

To date, \$2,040,206 has been spent in the watershed for installation of approximately 46 percent (based on cost of installation) of the needed land treatment measures. Fifty-seven percent of the watershed is covered by cooperative agreement with the local Soil and Water Conservation District. Approximately 26.4 percent (25,648 acres) of the watershed area is adequately treated. Of this 26.4 percent, 2.7 percent is cropland, 7.8 percent is pastureland, 14.6 percent is forest land, 0.3 percent wildlife and recreation land, and 1.0 percent land in other uses.

-Setting-

Three hundred and eighty-three watershed landowners are district cooperators, 293 of which have developed basic conservation plans covering approximately 42,400 acres. Soil surveys have been made on approximately 87,700 acres of watershed land (90 percent of the total area). (1) Table 1A reflects the status of land treatment in the watershed at the time of work plan preparation.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land Treatment

Inherently low fertility and very severe erosion potential are problems characteristic of approximately two-thirds of watershed soils. An estimated 8,700 acres of these lands are under cultivation, with one year out of three devoted to row crop production. Labor and capital resources committed to the crop production on these lands are producing marginal returns. Such lands should be voluntarily converted to grassland or forest land uses to provide adequate erosion protection.

Much of the remaining land under cultivation in the watershed has moderate to severe drainage problems or erosion hazards. Ability of these soils to produce efficiently both today and in the future requires an expanded voluntary effort by landowners in applying needed land treatment practices and improvements.

Additional on-farm water supplies are needed within the watershed to complement existing pasture enterprises and to encourage needed land use conversions from marginal cropland to pasture. Critically eroding areas are in need of treatment with vegetative species for stabilization.

Forest land areas, which constitute 40 percent of the watershed, are in generally fair hydrologic condition. Improvement in hydrologic condition and associated productive capability is dependent, however, upon continued protection of such from fire and grazing and upon a further intensification of management.

Overall economic capabilities of landowners and operators in the watershed presents a moderate limitation to application of needed land treatment on privately owned lands. Financial assistance beyond usual sources of cost share assistance now available to the area under RC&D will be needed for installation of some of the more capital demanding land treatment practices and measures. A continuing education and information program spearheaded by the county Soil and Water Conservation Districts is needed to effectively reach and motivate that segment of watershed landowners and operators who derive the majority of their income from non-farm sources.

Floodwater Damage

Damages to crops, pastures, other agricultural properties, roads and bridges are the principal floodwater problems in the watershed. These damages are associated with storms which generally occur two to three times per year. Twenty-nine percent of these flood-producing storms occur during May, June, and July when crops are most susceptible to damage. The probability of floods occurring in any given month is shown in the following table. (1)

-Problems-

<u>Month</u>	<u>Chance of Occurrence</u> (percent)
January.....	12
February.....	13
March.....	15
April.....	14
May.....	11
June.....	10
July.....	8
August.....	3
September.....	2
October.....	2
November.....	4
December.....	6

The agricultural flood plain covers 8,064 acres and includes 6,372 acres of cropland valued at an estimated \$4,300,000. The following table indicates acres flooded by project evaluation reaches (see project map) for the 1, 10, and 100 year floods (floods that have a statistical probability of occurring once in 1, 10, and 100 years respectively). This data is based on headwater flooding only and does not include backwater effects from the Ohio River.

Evaluation Reach	Annual Flood Without Project	10 Year Flood Without Project	100 Year Flood Without Project
1	698	798	846
2	167	283	337
2A	347	394	426
3	236	315	364
4	207	268	422
5	485	654	679
6	374	435	473
7	1,019	1,274	1,340
8	151	184	192
9	258	294	307
10	67	73	77
11	105	127	135
12	77	107	116
13	61	112	149
14	30	60	70
15	20	30	32
16	78	91	103
18	96	113	120
19	45	54	59
20	311	348	368
21	89	125	132
22	198	206	213
23	72	118	145
24	71	83	91
25	72	83	86
26	36	42	45
27	52	61	65
28	103	162	176
29	10	18	31
30	39	44	45
40	112	200	234
41	82	98	111
42	61	69	75
TOTAL	5,829	7,323	8,064

Considerable flooding in reaches 40, 41, and 42 is caused by backwater from Anderson River and/or the Ohio River. Damages in reaches 1, 2, and 2A are resultant from a combination of Anderson River headwater and Ohio River backwater. Floodwater damages in all other reaches are direct result of headwater floods of the Anderson River or its several tributaries. (See project map)

Damage to crop and pasture from such flooding is extensive. Farmers have reported crop losses ranging from 20 percent up to 100 percent from the most severe floods. Delayed planting and/or replanting associated with the flood problem causes increased crop production costs and decreased crop yields. Sediment deposition during flooding causes damage to plants by coating leaves with silt and clay particles. Capital and labor resources are underinvested in the crop production process because of the risk of reduced yields due to flood damages.

Based on the monthly probability of flood occurrence, crop and pasture damages

-Problems-

for future conditions without project are estimated at \$207,220 for the 100 year frequency flood event (8,064 acres inundated), \$173,784 for the 10 year flood (7,323 acres inundated) and \$117,311 for the annual flood (5,829 acres inundated).

In addition to crop and pasture damages, flooding results in underuse of flood plain land, and in excessive use of sloping upland. Some cropland areas in the flood plain have grown back into timber or are being used as pasture because of flooding.

Time and expense are involved in removing debris from flood plain areas, repairing fences, farm roads and tile outlets, removing sediment from drainage ditches and controlling weed infestations carried in by floodwaters.

Interruption of travel, mail and school bus service, and delay and inconvenience in feeding livestock constitute serious problems during flood periods. Flood damage is extensive to county roads and bridges in the watershed. Roads and bridge approaches are voided by the erosive action of floodwaters.

Bridge foundations are undercut by floodwaters and in some cases are rendered unsafe for vehicular use. Road and bridge repairs are expensive and often travel is interrupted until such repairs are made.

Erosion Damage

Sheet erosion is active throughout the watershed's rolling upland areas and serves as the primary sediment source. Approximately 90 percent of watershed soils have erosion hazards. Twenty percent of these soils are in cropland. Soil losses due to sheet erosion of flood plain cropland range between one and two tons per acre per year. Sheet erosion losses on flood plain pastureland and forest land are typically below one ton per acre per year. The nearly level flood plain soils do not possess the physical potential for excessive sheet erosion losses. Soil losses on cropland in the uplands range typically between 3 and 10 tons per acre per year and are generally in excess of the allowable loss of 3 tons per acre per year. An allowable soil loss is the soil loss in tons per acre per year which can be allowed on a specific soil and still permit a high level of crop production to be sustained economically and indefinitely. (20) Sheet erosion rates can run as high as 26 tons per acre per year on very steep upland soils that are plowed and planted to continuous row crops. Erosion rates on upland pastureland and grazed forest land range typically between three and seven tons per acre per year and are generally at or above the allowable limit. Erosion rates on undisturbed forest land and on land in State and National forests are generally at or below the allowable limit of three tons per acre per year but can run as high as eight tons per acre per year on extremely steep slopes. Erosion rates on all land presently adequately treated by conservation practices (approximately 25,648 acres) and used according to its capability are at or below the allowable limits.

Gully erosion is prevalent in isolated areas throughout the watershed. Areas affected are the more steeply rolling uplands. Affected areas are primarily idle land, cropland or pasture. Steep gradients with high flow velocities, marginal to inadequate vegetative cover and infertile soils are prime contributors to the gully erosion problem. Gully erosion rates range between 20 and 35 tons of soil loss per acre annually.

Approximately 400 acres of critically eroded land exist within the watershed. This

figure includes areas of gully erosion, rill erosion and severe sheet erosion which typically occur on small steep upland plots that range in size from 1 to 15 acres.

Flood plain scour is a significant problem within the watershed. Erosion occurs through the scouring effects of floodwaters on nearly level flood plain soils. Such scouring removes fertile topsoil leaving less fertile, wet depressional areas exposed. Crop production potential on such areas is reduced. An estimated 369 acres of watershed flood plain soils are seriously affected by this problem. Average annual damages from flood plain scour are estimated at \$5,241.

Stream bank erosion occurs throughout the watershed. In part, this condition is caused by large trees or debris blocks within main channel areas. Stream flow in such areas is deflected by these obstructions or made more turbulent. Localized erosion of channel banks results. Stream bank erosion is not a serious watershed problem.

Total gross erosion on the watershed averages 553,892 tons per year. Overall watershed erosion is approximately 98 percent attributable to sheet erosion, 1.5 percent to gully erosion and 0.5 percent to stream bank erosion and flood plain scour. Erosion damages significant to the formulation and evaluation of a structural program were limited to those associated with flood plain scour.

Sediment Damage

Sediment damage occurs predominantly in the upper reaches of watershed tributary streams. Channels in these areas fill with gravel and sand at major gradient breaks. Farm operators have had to remove sediment accumulations from these channels to prevent excessive flooding and rising ground water levels on adjoining lands.

Some sand and silt particles are deposited in the larger drainageways and cause channel flow restrictions at scattered points. This problem is characteristic of the normal cyclical pattern of natural streams. Sediment accumulations in existing watershed lakes are not excessive because of the high percentage of forest cover within their respective drainage areas.

Of the 553,892 tons per year gross erosion an estimated 40,000 tons are flushed from the watershed into the Ohio River annually.

Drainage Problems

Approximately 6,800 acres of watershed soils are imperfectly drained which limits agricultural use. Over 70 percent of these soils are currently used as cropland. Soils affected include the Bartle and McGary located in terrace positions in the watershed and the Stendal and Wakeland located in flood plain areas. These soils are suitable for crop production without drainage but yields are generally depressed, crop quality reduced and production costs increased. The remaining 30 percent of the imperfectly drained soils are in pastureland, forest land, and recreation land. The imperfectly drained soils are best suited for pastureland, but with drainage measures applied will sustain high crop yields. Outlets for tile and surface drainage of these soils are generally adequate throughout the watershed. Needed drainage measures have been installed on 20 percent of the affected area. High initial cost and the threat of frequent flooding have limited installation of these drainage measures.

-Problems-

Municipal and Industrial Water Problems

Ground water supplies are marginal for domestic use throughout all but the extreme lower portion of the watershed. Ground water resources generally must be supplemented from other water supply sources for large farm operations and for municipal and industrial use.

The existing water supply for the Saint Meinrad Archabbey is considered adequate in quality and quantity to the year 1985. Consulting engineers for the Saint Meinrad Archabbey have indicated a need for additional water supply based on an expected population increase from 669 people in 1969 to an estimated 1,645 people in 2020.

Existing municipal water supply for the Town of Birdseye is considered adequate by their consulting engineers (Midwestern Engineers, Inc., Loogootee, Indiana) for both present and future domestic needs. Water is not considered adequate, however, for future industrial growth.

Plant and Animal Problems

Cropland acreages within the watershed are on the decline, particularly in upland areas. Such areas are being converted primarily to forest land or pastureland use. Some of these areas are allowed to revert to brush which is the first natural successional stage in the evolution of climax forests. Wildlife habitats of forest land and forest land-pastureland "edge" are increasing. This benefits species such as deer and gray squirrel. Forest land-cropland "edge" is decreasing. This will be detrimental to species such as bobwhite quail, cottontail rabbit, and fox squirrel. (1)

Spring and summer flooding destroys eggs and the young of ground nesting animals and birds. Occasionally a brood year of a species in flooded areas could be adversely impacted, and, in some circumstances, completely eliminated by flooding. Effects of sediment laden floodwater and the decrease in water quality on fish have not been specifically evaluated.

Wildlife habitat for upland game and song birds is adequate to support current populations. Deer populations are below the carrying capacity of available habitat because of illegal hunting activities in the area and feral dog packs. (17)

Rare and endangered species are not known to exist within the Anderson River Watershed.

Water Quality Problems

A water quality assessment of the watershed was conducted by the U.S. Geological Survey. (21) Generally the surface water in the watershed was found to be of good quality.

Drainage from abandoned coal mines into Lanman Run, Meinrad Hollow, and Swinging Creek appear to be causing significant changes in the chemical, physical, and biological characteristics of these streams. A water sample of Lanman Run above a good sized strip mine had a field pH of 6.5, a specific conductivity (SC) of 105 micromhos, and contained 0.23 milligrams per litre (mg/l) of aluminum, 0.59 mg/l iron and no manganese. A small tributary to Lanman Run further

downstream drains a large surface coal mining and storage area. Water from this tributary had a field pH of 3.8, and SC of 520 micromhos, and contained 22.0 mg/l aluminum, 8.2 mg/l iron, and 4.8 mg/l manganese. Effects of this tributary showed up in samples of Lanman Run just downstream of their confluence, not only in the water samples, but also in the nature of the stream bottom materials. Bottom materials changed from clean sand and gravel above the mine to a higher percentage of fine materials (coal fines) below the mine. Similar results were found on Meinrad Hollow and Swinging Creek.

It was also determined that nitrate concentrations were higher in waters flowing from the more intensively cultivated bottoms. At the time of sampling, nitrate concentrations appeared to be related to fecal coliform and fecal streptococci bacteria concentrations. On the basis of fecal coliform/fecal streptococci ratios, the bacteria in the streams probably result from runoff of superficially deposited animal wastes and are contributing to nitrate concentrations. Concentrations appeared to be related to fecal bacteria should be reduced during periods of low flow when surface storm flows would be absent.

Stream waters flowing from upland areas generally contained less than 0.5 mg/l nitrate-nitrogen, which should present no water quality problems for the proposed reservoirs controlling upland drainage areas. Water flowing from the more intensively cultivated bottoms generally contain enough nitrate-nitrogen to cause enrichment and undesirable biologic growth, particularly if associated with an impoundment. However, no impoundments are planned for the bottom lands of the Anderson River.

None of the nitrogen values found in the basin are significant with respect to public use or consumption.

Anderson River bottom materials were sampled for insecticide residues at two sites. The sample collected near Birdseye did not contain any residues, but the sample collected near Saint Meinrad was found to contain residues of: chlordane, 3.6 micrograms per kilogram; DDT, 1.0 micrograms per kilogram; DDD, 0.5 micrograms per kilogram; and dieldrin, 2.7 micrograms per kilogram. These concentrations are considered low, but are an indication that these persistent compounds have made their way into the stream system. This leaves open the possibility for accumulation in biological food chains.

Sediment concentration samples were taken only to indicate the effects of Interstate 64 construction on downstream sediment concentration. The sample from Anderson River above the construction area contained 11 mg/l of suspended sediment. The sample below construction on Anderson River contained 22 mg/l or a 100 percent increase in concentration. The samples on Hurricane Creek reflect an even greater increase. The sample showed 12 mg/l above construction and 69 mg/l below the constructed site. When this temporary disturbance of soil is completed and stabilized, the sediment concentrations downstream should again return to the low concentration found upstream.

Recreation Problems

Population growth, rising standards of living, and increased amounts of time for leisure activities are creating increased demands for outdoor, water based recreation activities in the watershed and surrounding areas. The present population within a 25 mile radius of the watershed is estimated at 80,000 and over one-half million people live within a 50 mile radius.

-Problems-

The watershed has an abundance of scenic beauty, wooded hills and streams and offers opportunity for recreational use. Insufficient water areas and lack of adequate public recreational facilities limit utilization of the watershed's potential.

The Indiana State Recreation Plan states that this area is deficient in facilities to meet demands for most outdoor recreational activities. (22)

Projections for the year 2000 presented in the State Recreation Plan indicate needs for two additional regional parks, 19 district parks and numerous community, neighborhood and block parks. A regional park as defined in the State Recreation Plan is at least 1,000 acres in size, of which a minimum of 200 acres are water. Such parks would serve population within one hour driving time. District parks as defined would vary between 400 and 800 acres in size, of which a minimum of 48 acres are water. These parks would serve population within one-half hour driving time. Community, neighborhood and block parks are smaller yet in size with subsequently shorter travel time and distance.

Economic and Social Problems

Nearly 50 percent of the farms in the four watershed counties had less than \$10,000 total farm product sales annually. (23) Watershed farms are almost exclusively of the family farm type. Exceptions to this are found in flood plain areas where an estimated five percent of the farms employ greater than one and one-half man years of hired labor.

The percent of families with income below the poverty level for Crawford, Perry, and Spencer Counties is nearly double the State average. Dubois County, having a broader economic base, was near the State average. Per capita and median family incomes for the four watershed counties was also shown to be below State averages. The following table restates these relationships as percentage comparisons of County incomes to State. (Derived from data in reference listed for footnote No. 12).

<u>Item</u>	County Average/State Average (percent)			
	<u>Crawford County</u>	<u>Dubois County</u>	<u>Perry County</u>	<u>Spencer County</u>
Per Capita Income	72	85	76	74
Median Family Income	67	90	80	78

Additional employment opportunities are needed in Perry and Crawford Counties to lower unemployment from the current rates of 13.2 and 5.6 percent (14) respectively to at least current State and National averages (4.8 to 4.9 percent). (15) Whereas data was not available for Spencer County, it is believed that unemployment rates exceed State and National levels. Dubois County was below the State and National level. The lack of development and conservation of land and water resources has retarded improvement in social and economic conditions.

PROJECTS OF OTHER AGENCIES

Patoka Lake, a reservoir of nearly 9,000 acres (seasonal pool) for flood control, water quality, water supply and recreation, is currently under construction by the U. S. Army Corps of Engineers. The dam site, to the north of Anderson River Watershed, is located near Ellsworth, Indiana, on the main stem of the Patoka River. The seasonal (water supply) pool of the lake will extend upstream from the dam to a point approximately 3 miles west of State Road 37. At several points the permanent pool will be within two to three miles of the northern watershed boundary. Approximately 6,000 acres of land will be acquired specifically for outdoor recreational use. Certain areas of the reservoir will be zoned for power boating and others for no-wake boating. Recreation features of this project will satisfy needs for one of the two regional recreation parks outlined in the Indiana Outdoor Recreation Plan.

The U. S. Forest Service, acting in concert with the Bureau of Outdoor Recreation, is utilizing Land and Water Conservation Fund monies to acquire additional lands for recreation in the Anderson River Watershed. These lands will be complementary to the recreational facilities planned in this project.

PROJECT FORMULATION

Introduction:

The sponsors application for assistance under P. L. 566 was approved by then Governor Harold Handley on September 23, 1960.

In April 1967 the sponsors requested that SCS commence planning of the Anderson River Watershed.

A preliminary investigation report indicating project feasibility was completed in August 1967 and presented to the sponsors. Copies of this report were sent to the then Indiana Department of Conservation and the U. S. Forest Service. The Administrator of the Soil Conservation Service authorized the State Conservationist for Indiana to provide detailed planning assistance in October 1967. Notice of receipt of planning authorization and a request for notification of interest was sent to 10 Federal, State and local agencies. One Federal agency indicated interest in the project.

On January 27, 1968, the Perry County Circuit Court, following the recommendations of the Indiana Natural Resources Commission, established the Anderson River Conservancy District which immediately became a project sponsor. Public hearings were conducted on two different occasions during Conservancy District formation and once during review of a previously developed draft plan proposal. Monthly meetings were held by the local sponsors to sustain interest, establish goals, and to consult with other people that were interested in the project. About 30 meetings were held during project formulation between the sponsors and State, Federal or local agencies as well as the general public. Other unrecorded meetings were held with persons that had special or perhaps individual interests in the project.

Personnel from the Glenn A. Black Laboratory at Indiana University were consulted to determine the location of possible features of archeological significance within the watershed.

County historical societies were contacted for information on the presence of historic values within the watershed.

Three multiagency fish and wildlife, forestry, and water resource field reviews were held during the course of plan development. Such field reviews involved biologists, foresters, soil conservationists, geologists, and engineers representing the Indiana Department of Natural Resources, Division of Fish and Wildlife and Division of Forestry; the U. S. D. I., U. S. Fish and Wildlife Service; the U. S. Army Corps of Engineers; Indiana State Board of Health; and the Soil Conservation Service. The U. S. D. I., Geological Survey was employed to conduct a comprehensive water quality study. The specific recommendations made by these agencies were discussed with project sponsors and incorporated into the project plan.

Present use of watershed lands is predominantly agricultural. Future watershed land use is expected to remain essentially agricultural with some increase in home site developments and private recreational retreats. Greatest concentration of this type development is expected in the heavily wooded portions of the watershed near existing roads. Some home site development is expected on private

lands near watershed lakes. To a considerable degree future land use in the watershed is expected to trend toward the development of its multiple use potential, particularly on the less intensively used agricultural areas and woodlands. Sponsors and Service personnel are working with county officials to develop uniform zoning and sanitary regulations that will control private development so that it will be compatible with the environmental objectives of the project.

The planned system of land treatment and structural measures will do much to solve both short-term and long-term problems. Application of improved management practices and treatment needs under the land treatment program on crop, pasture, and forest land areas will enable farmers to achieve a more favorable income balance from their various land use commitments. Pressures to commit watershed land resources in the short run to uses more intensive than are consistent with long-term capabilities, will thereby be reduced. In serving the profit motive, owners of these agricultural areas will also serve man and his environment through the perpetuation of much of the area's present beauty and protection of its natural resources. Reduction of flood problems on flood plain areas will also contribute to this end in allowing for increased profitability on current cropped areas.

Planned measures to be installed under the project will complement projected long-term uses of land, water and other natural resources which are outlined in the Ohio River Basin study and the Indiana Outdoor Recreation Plan. (24) (22) Water resource developments for recreational purposes will serve as focal points from which many of the area's scenic and historical points of interest can be viewed. The project will yield on-site conservation benefits together with offsite benefits in the form of flood damage reduction, public recreation, and municipal and industrial water supply far beyond its projected 100 year life.

Many installed and potential watershed projects are found in this Ohio region, and many applications for assistance are pending. The works of improvement in the Anderson River Watershed will complement the measures already installed in the Middle Fork of Anderson River Watershed project, which is the next watershed to the east.

The Anderson River drains directly into the Ohio River. The Anderson River Watershed comprises 0.07 percent of the Ohio River watershed or region. It is also part of the Evansville-Green subregion as classified by the United States Water Resources Council, and makes up about 0.3 percent of that subregion. Because of the minute percentage of the region and subregion that this watershed occupies, any effect that this work would have on the region or subregion is considered negligible.

Objectives:

Watershed Protection. One goal of the project sponsors and the Soil Conservation Service is to reduce the recognized problem of excessive erosion on watershed land. Soil losses can be reduced in two ways: (1) by voluntary changes in the use of seriously eroding land to some use that would protect the soil resource; (2) by applying vegetative and structural measures on eroding land to protect the soil resource without significantly changing the land use. These two basic principles can be applied to seriously eroding cropland, pastureland, forest land, and land in other uses to effectively reduce erosion to an allowable level.

-Formulation-

It was recognized that the application of soil conservation measures would satisfy several objectives of the sponsors, the Soil Conservation Service, and the public in general. Conservation practices applied to cropland, pastureland, and forest land would facilitate the efficient production of agricultural projects without depleting the soil resource. The economy would be stimulated. Wildlife would benefit from special wildlife plantings and vegetative measures used to retard erosion. The value of water in watershed streams for fish, wildlife, and human use would be increased as a result of reduced sedimentation. In summary, the goal of reduced watershed erosion was set because it would allow watershed residents to fully utilize their soil resource and at the same time improve the quality of the environment.

Flood Prevention. Another goal was flood prevention. Many generations of flood plain landowners have lived in fear of frequent flooding, which at one time or another has damaged crops and land on every acre of flood plain soil. Farm operators have been reluctant to invest capital and labor toward maximum production of agricultural products because of a fear of losing the investment. They recognized that tons of precious topsoil were being flushed downstream where it would become an economic problem for their fellow man and a nuisance to fish and wildlife. Through the local Soil and Water Conservation Districts the watershed landowners learned that flood prevention measures in conjunction with watershed protection could reduce their flood problems as well as erosion and sedimentation. Other objectives could be met as well. Watershed streams would flow longer during periods of dry weather and maintain their clarity during periods of runoff. Fish and wildlife would benefit from cleaner water.

The sponsors felt that they should set a goal to reduce the flooding on 6,000 acres of flood plain land immediately adjacent to the Anderson River and its major tributaries. The sponsors realized that watershed landowners would have to make some sacrifices to achieve this flood prevention goal but felt strongly that this goal was attainable and worthwhile.

Fish and Wildlife. A third project goal is to establish and improve wildlife habitat while minimizing habitat losses resulting from project installation. Vegetative watershed protection measures were planned to include species of plants that provide cover and food for a variety of animals and birds. Plantings intended solely for wildlife use were also included. Less intensive use of erosion prone land was recognized as being a benefit to wildlife as well as a soil conservation measure. The sponsors felt that sediment reductions in watershed streams as a result of watershed protection and flood prevention measures would improve the watershed stream fishery. The establishment of lakes and farm ponds would create an extensive lake type fishery and provide a constant water supply for wildlife. Vegetative measures, land use changes and special design features associated with watershed lakes were planned as mitigation for wildlife habitat destroyed by project installation. In summary, the goal of the sponsors and the Service is to create a better environment for the growth and reproduction of fish and wildlife within the watershed.

Recreation. The recreation goal of the U. S. Forest Service is to help meet the demand for a regional park (22) and to provide facilities that would encourage use of our publicly owned forest lands. They feel that a lake of approximately 600 acres and facilities for camping, picnicking, boating and swimming that can accommodate a total of 1,300 people at one time will achieve this goal.

The recreation goal of the Perry County Park and Recreation Board is to provide

a district park that would provide for the recreational needs of people living within one-half hours drive of the park. (22) Their desire is to create facilities for camping, nature study, picnicking, boating and swimming that can accommodate a total of 1,200 people at one time.

Municipal and Industrial Water Supply. A fifth project goal is to provide additional water supplies to meet the future needs of the Archabbey at Saint Meinrad and the Town of Birdseye. Consulting engineers for the Saint Meinrad Archabbey have indicated a need for additional water supply based on an expected population increase from 669 people in 1969 to 1,645 people in 2020. The present water supply at the Archabbey will be adequate until 1985. Additional water storage of 582,000 gallons will be needed to meet the demands of the Archabbey in the year 2020.

Existing municipal water supply for the Town of Birdseye is considered adequate by their consulting engineers for both present needs and future growth. Water is not considered adequate, however, for future industrial growth. Therefore additional water supplies are necessary to attract industry which in turn will stimulate the town's economy.

Project in Brief:

Land treatment measures outlined in this plan will contribute to the project objectives of reduced runoff, reduced erosion, and improved resource development. This phase of the project will encourage proper use and treatment of all lands in the watershed within their capabilities. The application of these measures, in addition to improving the quality of agricultural and forestry products, will enhance the project by extending the useful life of the proposed structures through reduced sedimentation.

Conservation land treatment measures to be installed in the watershed will reduce annual erosion from an estimated 553,892 tons per year to 427,566 tons per year, a 23 percent reduction. Sediment concentrations in watershed stream flows will be reduced in like proportion. Structural measures planned include the following:

1. One multiple purpose structure for flood prevention, recreation and industrial water supply. (Structure No. U-1)
2. One multiple purpose structure for flood prevention and recreation. (Structure No. U-10)
3. One multiple purpose structure for flood prevention and municipal water supply. (Structure No. L-24)
4. Forty-six small single purpose floodwater retarding structures.
5. Approximately 10.5 miles of channel work on the Anderson River main stem, consisting of debris block removal and the removal of hazardous trees from the channel flow area.

The structural works of improvement were selected to economically meet the objectives of the sponsors insofar as possible, consistent with physical characteristics, engineering criteria, and Service policies. Structural

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measures were selected that would do the least damage to the environment, particularly preserving the most fish and wildlife habitat.

The sponsors and the Service agree the measures provided in this work plan will accomplish the major objectives and provide an opportunity for economic growth in the area.

The sponsors feel strongly that the accomplishment of these objectives will create a better environment for people living in the area. The sponsors also believe that the installation of the works of improvement will serve as a stimulus to economic growth and activity in the area, providing local employment and business activity.

Environmental Considerations - Because the contributing drainage area above each of the recreation reservoirs is heavily forested, the quality of the water impounded should be good and create no problems for the water contact type of recreation planned. All the drainage area above structure No. U-1 is within the U.S. Forest Service purchase area boundary and 66 percent of structure No. U-10 is within this boundary. The U.S. Forest Service presently owns about 60 percent of the drainage area above structure No. U-1 and about 25 percent above structure No. U-10. State Department of Health water quality standards will be the minimum used by the U.S. Forest Service and the Perry County Park and Recreation Board at reservoirs U-1 and U-10 respectively. Monitoring the water at regular intervals will be the method used to determine quality at any particular time.

Evaluated effects of the project indicate that no portion of the watershed will suffer flood increases. There will be no induced downstream damages within or outside of the project area. Because of flooding caused by backwater from the Ohio River, reductions in flood stages due to this project outside of the project area will not be significant.

While the sponsors desired to achieve a 60 percent reduction in overall watershed flood damages, an overall damage reduction of only 48 percent was found to be feasible. This was the optimum that could be provided within the constraints of economic feasibility and minimal adverse impact.

Some fish and wildlife habitat changes will occur as a result of this work. Channel work will be limited to some drift and hazardous tree removal. Some wildlife habitat will be lost due to the impoundments created by the reservoirs.

A multiagency review team, inspected the watershed in February 1972 in an effort to assess impacts on fish and wildlife habitat and recommended ways to minimize adverse impacts. This team consisted of specialists from the U.S. Forest Service, U.S. Fish and Wildlife Service, Indiana Department of Natural Resources and the Soil Conservation Service. This team felt that no adverse impact would result from the channel work proposed. Their recommendations for mitigating habitat losses to fish and wildlife caused by impoundments and channel work are as follows.

The multipurpose recreation structures should be equipped with an outlet near the bottom of the dam so that the pool can be provided with the maximum drawdown capability practicable. In addition, the U. S. Forest Service impoundment outlet should be multileveled (near bottom and near middle), thereby assuring not only maximum

practicable drawdown capability but the best water quality discharge. All other structures should be designed so maximum drawdown can be obtained in a feasible manner (pumping, siphon, etc.). All activities on the final stages of construction of the impoundments to be managed by the Indiana Department of Natural Resources should be coordinated between the Conservancy District and the Department of Natural Resources so this work can be accomplished with the minimum effort and delay.

In single purpose structures, as mitigation for the losses of wild-life habitat due to flooding, the area in the easement from the flood pool line to the sediment pool line should be designated as watershed wildlife area with appropriate permanent markers. This land would be allowed to undergo natural successional changes from its present condition(s) with the following exceptions:

1. If the current use of definable area is permanent or definite rotation pasture, this practice may continue if stock access to the pool is limited to a specially-constructed watering area that is fenced, stone walk-way, etc.
2. If hay cutting has been a regular practice, it could continue within the following dates: June 15 to August 31.
3. Borrow areas, erosion areas, and areas on and near dams will be planted to grasses, legumes, shrubs, trees or a combination.

Multipurpose Structures. These will require mitigation in the form of the dedication of wildlife habitat similar to that destroyed, either on existing or replanted lands. It is believed sufficient areas for this purpose should be available within the boundaries of these developments and recommendations can be made when plans for these developments are finalized by an interagency multidisciplinary team.

Channel Work. It is understood that no major inchannel work will be necessary. Habitat alteration along the stream will be limited to some drift removal and hazardous tree removal under a lumberman's contract. In this case and if the planning is done by an interagency multidisciplinary team, no additional mitigation would be necessary.

All these recommendations have been included in the plans for the structural measures.

Wooded areas at selected reservoirs will be fenced to prevent grazing cattle from destroying the undergrowth and ruining habitat.

The fish and wildlife management plan for structures U-1 and U-10 will be developed jointly by the Indiana Department of Natural Resources and the Forest Service.

Installation of structure No. U-10 and its associated recreation development will displace two owner occupied dwellings and one farm operation. The sponsors

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have determined that replacement dwellings and farms are available within the general area. The economic impact of the lost farm operation to businesses or markets in the area will not be significant. Social ties of displaced persons are not expected to be significantly affected. No other relocations or displacements are anticipated.

Alternatives.

1. One alternative would be the installation of conservation land treatment practices only. Practices and measures of two general types were analyzed, namely, 1) those which commonly appear in conservation plans and accrued benefits primarily onsite and 2) those installed for other purposes such as downstream flood reduction.

Land treatment measures of the first type were found effective in meeting watershed needs for erosion protection, for on-farm water resource development (e.g.-farm ponds), and for agricultural drainage. In providing erosion protection, these measures were also found effective in reducing downstream sediment problems in the watershed. They would reduce annual erosion from 553,892 tons to 427,566 tons which means delivery to streams is reduced 23 percent. These measures would adequately treat approximately 170 farm ponds. These measures did little toward reducing flood damage.

Land treatment measures for the specific purpose of floodwater detention were also studied as an alternative. Such measures reduced downstream flood damages only 3 percent at a total cost of \$2,999,403. Required local financing was less with a structural program.

2. A channel only solution to watershed problems was never seriously considered by local sponsors. Channel work was considered to be too environmentally damaging to be acceptable. A project of this nature would not give adequate flood prevention and could not meet the recreation and water supply needs of the area. Also, Service policy dictates that if reservoir sites are available these should be investigated first as a solution to flooding before channel alternatives are considered.
3. Nonstructural measures to reduce flood damages were considered as an alternative. Flood plain zoning is an effective means of preventing undesired development and reducing damages. Approximately 80 percent of the flood plain is cropland with a few utilities, roads and bridges and an occasional farm building or home. Implementation of zoning ordinances is a power delegated to county government in the State of Indiana. No zoning regulations exist within the watershed counties. Zoning would also be a means of converting the flood plain to a less intensive use although agriculture is usually considered a use compatible with a flood plain. A method of flood plain management annually, to some less intensive use. The average annual net return foregone by converting this cropland to pastureland would be approximately \$100,000.

4. The first structural solution considered was a plan consisting of land treatment measures, 15 single purpose floodwater retarding structures, 3 multiple purpose structures and 14.8 miles of channel excavation. This combination of land treatment and structural measures would reduce flood damages by 54 percent as well as meet the objectives of erosion control, recreation and water supply. While this proposal had a favorable benefit cost ratio, the inclusion of channel work made it unacceptable to the sponsors. The total cost of this alternative solution was estimated at \$8,920,082 with a benefit to cost ratio of 2.1 to 1. (Using the 1969 price base.)
5. Another alternative to the proposed action is no project. Adverse environmental effects of the planned improvements would thereby be eliminated, however, a no project solution also implies other adverse effects on the environment. Erosion, continuing unchecked, will continue to defile the streams of the area with sediment. Upland and flood plain soil resources will continue to deteriorate at excessive rates without accelerated land treatment. Lack of flood protection and major water resource development will perpetuate the depressed economic conditions which plague much of the area currently. Nearly \$220,082 of annual net benefits resulting from the project would be foregone if a no project solution were adopted.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Conservation land treatment practices and measures included in this plan will adequately treat 42,582 watershed acres during the project installation period. This land treatment will be voluntarily applied by landowners throughout the entire watershed and will supplement the on-going land treatment program. An estimated 10,737 acres of the total is cropland, 18,002 acres pastureland, 10,500 acres forest land and 3,343 acres land in other uses. The following is a listing with definitions of land treatment measures to be applied respectively to cropland and grassland. (25)

Land Treatment Measures to be Applied to Cropland

1. Contour Farming: Farming sloping cultivated land in such a way that plowing, preparing land, planting, and cultivating are done on the contour. (This includes following established grades of terraces, diversions, or contour strips.)
2. Grade Stabilization Structures: A structure to stabilize the grade or to control head cutting in natural or artificial channels. (Does not include structures used in drainage and irrigation systems primarily for water control.)
3. Subsurface Drains: A conduit, such as tile, pipe, or tubing, installed beneath the ground surface and which collects and/or conveys drainage water.
4. Drainage Field Ditches: A graded ditch for collecting excess water within a field.
5. Diversions: A channel with a supporting ridge on the lower side constructed across the slope.
6. Grassed Waterways or Outlets: A natural or constructed waterway or outlet shaped or graded and established in vegetation suitable to safely dispose of runoff from a field, diversion, terrace, or other structure.
7. Terraces: An earth embankment or a ridge and channel constructed across the slope at a suitable spacing designed to prevent soil erosion.
8. Conservation Cropping Systems: Growing crops in combination with needed cultural and management measures. Cropping systems include rotations that contain grasses and legumes as well as rotations in which the desired benefits are achieved without the use of such crops.

Land Treatment Measures to be Applied to Pastureland

1. Pasture and Hayland Management: Proper treatment and use of pastureland or hayland.

2. Pasture and Hayland Planting: Establishing and reestablishing long-term stands of adapted species of perennial, biennial, or reseeding forage plants. (Includes Pasture and Hayland Renovation. Does not include Grassed Waterways or Outlet on cropland.)
3. Ponds: Water impoundments made by constructing a dam or embankment or by excavating a pit or "dugout".
4. Spring Development: Improving springs and seeps by excavating, cleaning, capping, or providing collection and storage facilities.

A land treatment program has been developed for private forest lands from a statement of land treatment needs prepared by the Division of Forestry of the Indiana Department of Natural Resources in cooperation with the U. S. Forest Service. The following program is planned for installation on private forest land.

Forest land management plans will be prepared for approximately 101 landowners, involving 5,480 acres, to provide for the proper installation and maintenance of forestry measures on private land.

Tree planting on 430 acres of appropriate open lands in private ownership is necessary to adjust planned use with capability and to reduce runoff and erosion by developing a protective cover and absorbent forest floor of litter and humus.

Hydrologic cultural operations are needed on 4,565 acres to improve the hydrologic conditions of private forest lands by manipulation of stand composition to create conditions favorable for the maximum production and protection of litter, humus, and forest cover. They include thinnings, weedings, improvement, salvage, intermediate harvest and harvest cuttings, supplemental plantings, and protection from overgrazing by domestic livestock.

During development of resource conservation plans, landowners will be encouraged to plan and apply forest management practices that are important in developing or maintaining favorable wildlife habitat conditions.

The existing programs of the U.S. Forest Service on National Forest System lands, which include erosion control, reforestation, silvicultural treatments, fire control, and resource development will be continued. The land treatment program for National Forest System lands in this watershed include hydrologic stand improvement and tree planting on 40 acres.

The proposed forest land treatment program on the State Forest lands includes 25 acres of tree planting and 1,600 acres of hydrologic cultural operations.

Nonstructural Measures

Present flood plain land use is agricultural cropland, forest land and pastureland. The only structures presently in the flood plain are roads, bridges and utilities. Agricultural use of a flood plain is compatible with a flood plain management plan that minimizes damage and loss of life. Flood protection provided by this plan is not sufficient for more intensive flood plain use. Flood plain zoning is the most reasonable alternative in preventing more intensive development. The years ahead are expected to bring zoning ordinances of this type. The county governments already have the authority to implement zoning ordinances.

-Works to be Installed-

Structural Measures

Structural measures planned include the following: (See Project Map; back of plan.)

1. Forty-six small single purpose floodwater retarding structures.
2. One multiple purpose structure for flood prevention, recreation and industrial water supply (Structure No. U-1).
3. One multiple purpose structure for flood prevention and recreation (Structure No. U-10).
4. One multiple purpose structure for flood prevention and municipal water supply (Structure No. L-24).
5. Approximately 10.5 miles of channel work on the Anderson River main stem, consisting of debris removal and the removal of hazardous trees from the channel flow area without excavation.

Reservoir Type Structures

Foundation conditions under all structures consist of shallow alluvium over bedrock. Alluvial deposits can easily be removed and backfilled with a tight, well compacted soil as necessary, to assure structural safety and minimal inlet and pipe settlement.

The principal spillways on all structures will consist of reinforced concrete inlets with reinforced concrete pipe outlets. Gated outlets are provided for all structures to allow drawdown for reservoir management. Multiple purpose structures Nos. U-1 and U-10 will in addition be provided with multilevel gates.

Emergency spillways on structure Nos. U-1, U-4, U-10, and L-30 will be cut through rock. All other structures will have vegetated earth emergency spillways.

All structures will have two stage inlets storing one inch of flood runoff between the high and low stages. This is the runoff expected from one to two year frequency storms.

Model studies for this type of structure have been conducted by Mr. Charles A. Donnelly, Hydraulic Engineer with the U. S. Department of Agriculture, Agriculture Research Service, Soil and Water Conservation Research Division, St. Anthony Falls Hydraulic Laboratory, in Minneapolis, Minnesota. Mr. Donnelly developed generalized criteria for two-way uncontrolled drop inlets for closed conduit spillways.

The design for the drop spillways will incorporate Mr. Donnelly's generalized criteria.

Structures U-1 and U-10 will be designed so the emergency spillways will not flow more frequently than once in 100 years.

Structures U-4, U-17, L-13, L-32, L-40, L-50, and L-51 will be designed so

the emergency spillway will not flow more frequently than twice in 100 years. All other structures will be designed so the emergency spillways will not flow more frequently than 4 times in 100 years.

All dams will be constructed of earth fill. Rock encountered in the required excavations will be utilized in the dams.

Clearing of the single purpose sites will be limited to that area necessary for construction of the dams and emergency spillways, and the borrow areas. It is estimated that this clearing will amount to 70 acres for the dams and spillways, and 188 acres for borrow. The primary source of borrow will be the reservoir areas. Clearing at site U-1 will amount to 205 acres, and 36 acres at site U-10. Timber having no commercial value will remain uncleared in the upper reaches and in selected laterals and bays of multiple purpose structures No. U-1 and U-10 permanent pools, and in those pool areas of all other structures not utilized for borrow purposes. Clearing at site L-24 is estimated at 5 acres, mostly for the dam and spillway. Landowners will be encouraged to remove all timber of commercial value prior to construction.

All structures are designed with an expected life of 100 years. Low stage floodwater inlets for the single purpose floodwater retarding structures are set at the 100 year submerged sediment pool elevations. Approximately 90 percent of the total sediment accumulation will be submerged. The entire submerged sediment storage capacity of the single purpose floodwater retarding structures will be used for water storage purposes initially. Such storage capacity will be displaced gradually with sediment over the 100 year design life of the structures. Readily available borrow material of alluvial deposits exist at all sites.

Primary borrow sources for fill material will be within the land rights areas needed for dams, emergency spillways, and reservoir permanent and flood pools. If these sources should be inadequate, additional borrow sources will be obtained in upland areas or from the downstream flood plain.

Environmental protective measures, such as desilting basins, temporary seeding, and noise reduction equipment will be specified in each construction contract.

Installation and subsequent operation and maintenance of all structural measures will be in accord with State and local public health and safety regulations. Guidelines from the U. S. Public Health Service will be used in the design of watershed features, to minimize vector problems related to project installation. (26)

Minimum land rights required for the 46 single purpose floodwater retarding reservoirs is 860 acres, of which 173 acres are cropland, 264 acres are pastureland, and 423 acres are forest land. Of this, 276 acres will be committed to water storage in reservoir sediment pools. Four hundred and fifty three acres will be committed to reservoir retarding pools. The remaining 171 acres will be dams, emergency spillways and emergency spillway flowage easements. Two of these 46 single purpose sites, U-18 and U-38, are on Federal land administered by the U. S. Forest Service. Eight others, U-4, U-8, U-17, U-28, U-29, U-35, L-6, and L-13, are on State land administered by the Division of Forestry, Department of Natural Resources. Of the 46 single purpose reservoirs planned, five appear physically suited or have potential for incidental recreation use. These sites are U-12, U-37, L-30, L-46, and L-55. Very limited private recreation use is expected at those 36 single purpose reservoirs constructed on

-Works to be Installed-

private land. This can be expected primarily from the adjoining landowners and their guests, and will decline as sediment accumulates in the pool areas. Because the project's planned recreational features satisfy the area's anticipated needs, neither the sponsors nor private landowners will provide public access at those reservoirs built on private land. Public access at those 10 sites constructed on public land will be controlled in accord with the appropriate agencies management plan. If access is allowed, sanitary facilities will be provided by the agency in accord with all State and local public health and safety regulations.

Minimum land rights required for structure No. U-1 are 792 acres, of which 77 acres are cropland, 153 acres are pastureland and 562 acres are forest land. Surface area of the permanent water pool is 654 acres. All portions of the dam, reservoir, peripheral access and associated recreational development will be on Hoosier National Forest land and will be open to the public.

Minimum land rights required for structure No. U-10 are 274 acres, of which 134 acres are cropland, 19 acres are pastureland, and 121 acres are forest land. The dam, reservoir, access and associated recreational development will be on land to be purchased by the Perry County Park and Recreation Board, and will be open to the public. Land rights required for the recreational facilities are 156 acres, of which 3 acres are cropland, 47 acres are pasture, and 106 acres are forest land. The recreation pool contains 152 acres. Seventy-four acres will be committed to the retarding pool. The remaining 48 acres will be the dam, emergency spillway, and emergency spillway flowage easements.

Minimum land rights required for structure No. L-24 are 39 acres, of which 5 acres are cropland, 24 acres are pastureland and 10 acres are forest land. The municipal water storage pool will occupy 21 acres. The retarding pool will be 10 acres. The remaining 8 acres will be dam, emergency spillway and emergency spillway flowage easement. Public access and use of this area will be limited by the Anderson River Conservancy District to that which is compatible with the water supply purpose.

Structure U-1 will provide 100 acre-feet of industrial water for the Town of Birdseye. This water will be released through the principal spillway and picked up at a downstream point. Release of this water will be provided through one of the inlet gates. An agreement will be worked out between the U. S. Forest Service and the Town for water release. The storage provided allows for a monthly use of 3,000,000 gallons, an average daily use of 100,000 gallons and a peak daily use of 300,000. Removal of this water will cause minimal interference with the recreation activities. Complete withdrawal of the 100 acre-feet will lower the pool by less than 2 inches.

The Anderson River Conservancy District is providing 120 acre-feet of water at structure No. L-24 with the intention of selling it to the Saint Meinrad Archabbey. This volume includes storage of 100 acre-feet for future needs at the Archabbey and 20 acre-feet to offset storage and transmission losses. The 100 acre-feet of usable water supply will provide for a monthly use of 3,000,000 gallons and an average daily use of 100,000 gallons. Water supply storage will be released through a gated outlet on the structure principal spillway. Such water will flow down the natural channel to a pick up station from which it will be piped to the treatment plant.

Disposal of used municipal and industrial water taken from water supply pools will be done according to Indiana State Board of Health regulations. (27)

Four-tenths miles of gravel road at structure No. L-55 and 0.2 miles at structure No. U-12, which are inundated by the retarding pools, will be raised. Two-tenths miles of road inundated at structure No. L-40 will be realigned. In addition, an abandoned farm house at site L-55 will be removed.

Six and six-tenths miles of roads flooded by structure No. U-1 will be closed. The U. S. Forest Service will consider using such dead end roads as potential access points in the overall management plan which will be developed for the area. Three miles of telephone line presently located in the retarding pool will be moved. Approximately 70 graves from the Blunk cemetery are located within the proposed permanent and retarding pools of structure No. U-1. Remains from these graves will be moved to some appropriate location above floodwater elevation. Removal of remains and subsequent re-burial will be accomplished according to Indiana law and State Board of Health regulations. This will be accomplished prior to or during construction of the dam.

One and three-tenths miles of local roads flooded by structure No. U-10 will be closed. Five abandoned buildings will be removed, and 2 miles of REMC line locations will be changed.

The only known relocations will occur at structure No. U-10, these are one displacement of farm business and two displacements of owner occupied dwellings resulting from the acquisition of land rights for the structure and associated recreational development. Displacement of dwellings will involve nine persons in one instance and two persons in the other. Uniform relocation assistance will be provided to any other persons determined to be eligible during the construction period.

In single purpose structures and multiple purpose structure No. L-24 as mitigation for losses of wildlife habitat due to flooding, the easement area from the flood pool line to the sediment pool line should be set aside as a wildlife area with appropriate permanent markers. This land would be allowed to undergo natural habitat successional changes from its present condition(s) with the following exceptions:

1. If the current use of a definable area is permanent or definite rotation pasture, this practice may continue if stock access to the pool is limited to a specially constructed watering area that is fenced, stone walkway, etc.
2. All wooded areas of one-half acre or larger within single purpose structure flood pools will also be fenced when in association with areas of definable pasture use.
3. If hay cutting has been a regular practice, it could continue within the following dates: June 15 to August 31.
4. Areas disturbed by construction activity and other critical erosion areas will be planted to grasses, legumes, shrubs, trees or a combination of these plants.

Dam and emergency spillway areas of all structures subject to livestock pasturing activities will be fenced to exclude livestock.

These procedures will provide benefits to the vast majority of the numerous

-Works to be Installed-

wildlife species of this watershed area at some stage of succession. This will be done within the land rights necessary for the structural measures.

Multiple purpose structure Nos. U-1 and U-10 will require mitigation in the form of the dedication of wildlife habitat similar to that destroyed, either on existing or replanted lands. Sufficient areas for this purpose are available within the boundaries of these developments. Multiple purpose structure Nos. U-1 and U-10 will be provided with multilevel gates. This will allow for the regulation of water quality in base flow discharges passed through the structures to downstream fishery area.

All dam and emergency spillway areas and those borrow areas outside of structure permanent pools will be seeded immediately following construction with a mixture of grass, legumes and/or low growing woody species conducive to wildlife use and protection of the structural features. Sufficient soil material will be left in borrow areas outside of structure permanent pools for the establishment of such vegetation. Borrow materials will not be removed from any area which may endanger structure stability of water retention capability. Timber from cleared area will be disposed of by anchoring in the permanent pool area to provide fishery habitat and stacking on shore for wildlife habitat. All merchantable material may be sold. All other construction activities will be conducted in such a manner as to minimize onsite erosion and sediment production. Sediment traps will be constructed below erosive areas to catch construction related sediment. The multiagency team will assist in developing the clearing plans and reviewing the borrow areas for structures U-1 and U-10.

The Crawford County Historical Society reported the existence of an old grist mill adjacent to Mitchel Creek. This mill would be in the permanent pool of structure No. U-1. An intensive field search has failed to substantiate its existence. The Forest Service is aware of this reported site.

Channels

Planned channel work will consist of the removal of fallen trees, trees in danger of falling and debris from the flow area of that portion of the Anderson River channel extending from the confluence with Hurricane Creek downstream to the Huffman bridge. An estimated 80 trees and 5 debris blocks will be removed from this 10.5 mile reach. Trees on channel banks and overbank areas will not be disturbed except where necessary for removal or disposal operations. Debris blocks will be removed with the least possible disturbance to trees and vegetation adjacent to the channel bank and to the earth of the channel bottom and banks. Debris entirely below normal water line will not be removed. Equipment to be used or debris or bar removal will not be allowed in the stream, except floating types. Ingress and egress to each work area will be accomplished without traveling within the channel and without destruction of woody habitat within 20 feet of the channel bank. The work area will be only as large as required and any clearing done will preserve desirable trees and not destroy the canopy. The contractor will be thoroughly briefed concerning work procedures that are necessary to protect the stream and the involved natural resources. Trees and debris removed during construction will be buried or tied down in adjacent areas to the channel.

Bank erosion areas associated with channel obstructions will be stabilized by shaping and riprapping. Flow velocities in the modified channel will be kept within allowable limits commensurate with stability of channel bank and bottom

areas. An illustration of the type and extent of planned channel work is shown as Figure 3. Sediment production and disturbance to fish and wildlife habitat will be kept to a minimum during construction through the utilization of hand equipment wherever possible for obstruction removal operations. The multi-agency team will assist in developing the final plan and only trees marked will be removed.

Minimum land rights required for the planned channel modification are 78 acres, all of which is forest land. Land use in channel construction areas will not be significantly affected.

A multiagency field review for planning has determined that fishery and wildlife mitigation measures will not be required for the planned debris and obstruction removal operation.

Public Recreation Facilities

Multiple purpose structure No. U-1 is planned for the purposes of flood prevention, industrial water supply and public recreation. Surface area of the permanent water pool is 654 acres. Land rights required for structure No. U-1 are 792 acres. All portions of the dam, reservoir, peripheral access and associated recreational development will be on Hoosier National Forest land and will be available for recreation use, and open to the public. No additional land rights for the recreational facilities will be needed.

Recreation facilities to be provided by the U. S. Forest Service include a beach and bathhouse, 20 camping units, 20 picnic units, 1 group picnic unit, 1 boat ramp, a sewage system, water system, two-way blacktop access roads and parking facilities. Design capacity of the development is for a maximum of 1,300 people at one time. The facilities are located north of the dam and spillway on the west side of the reservoir.

The Forest Service will be responsible for the design, administration of contracts and all costs associated with the recreational development at structure No. U-1.

Multiple purpose structure No. U-10 is planned for the purposes of flood prevention and public recreation. The surface area of the permanent water pool is 152 acres. Minimum land rights required for the structure are 274 acres, and for the recreational facilities are 156 acres.

The planned recreational development is north of the reservoir and has a design capacity for a maximum of 1,200 people at a given time. Public access around the reservoir will be assured by purchase of the 430 acres by the Perry County Park and Recreation Board.

Recreation facilities to be provided include a beach and bathhouse, 60 camp sites, 1 boat ramp and 18 boat docks, 2 toilet units, 1 shower unit, a sewage system, water system, nature trail, roads and parking areas. A portion of the recreational development is adjacent to the Ferdinand State Forest. This will increase opportunities for public recreation and use.

The two recreational structures in this plan will complement the four existing public recreation structures in the Middle Fork of Anderson River Watershed.

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The result will be a network of public recreation structures and facilities extending 20 miles in a north-south direction.

The associated recreational facilities are planned to complement the recreation pools at both sites U-1 and U-10, and will facilitate use and management of the areas. In all cases consideration will be given to the physically handicapped in the design of the facilities.

EXPLANATION OF INSTALLATION COSTS

Land Treatment

The cost of installing the land treatment measures are summarized in Table 1. Such costs total \$2,999,403 of which \$620,400 are for technical assistance and \$2,379,003 for application. Technical assistance costs are borne by P.L. 566 funds (\$400,000), funds of other programs administered by the Service (\$195,200) and funds administered by the U. S. Forest Service (\$25,200). Application costs for land treatment on private land will be borne by watershed landowners and operators (\$2,378,103), and on Hoosier National Forest land by funds administered by the U. S. Forest Service (\$900).

A projected schedule of P.L. 566 and other obligations for the installation of land treatment measures is as follows.

<u>Year</u>	<u>Forest Land (*)</u>		<u>All Other Land (**)</u>	
	<u>P.L. 566</u>	<u>Other</u>	<u>P.L. 566</u>	<u>Other</u>
	<u>(dollars)</u>	<u>(dollars)</u>	<u>(dollars)</u>	<u>(dollars)</u>
1	1,800	5,300	37,320	290,740
2	2,000	6,000	37,320	326,061
3	2,500	7,500	37,320	312,928
4	3,000	9,000	37,320	261,924
5	3,000	9,000	37,320	229,365
6	3,000	9,000	37,320	196,752
7	3,000	9,000	37,320	206,507
8	3,000	9,000	37,320	192,356
9	3,000	9,000	37,320	251,051
10	<u>2,500</u>	<u>7,500</u>	<u>37,320</u>	<u>251,419</u>
Total	<u>26,800</u>	<u>80,300</u>	<u>373,200</u>	<u>2,519,103</u>

(*) Assisting agency is the U. S. Forest Service.

(**) Assisting agent is the Soil Conservation Service.

Structural Measures

Installation costs for structural measures to be borne by P.L. 566 and Other funds are shown by cost account category in Table 2 and in summary form in Table 1. Such costs include the expense of construction, engineering, land rights, relocation payments and project administration. The "Watershed Work Plan Agreement" at the front of this plan outlines financial responsibility of Sponsoring Local Organizations and participating Federal and State agencies for all categories of structural installation costs.

Construction cost consists of the estimated contract cost of all materials, labor, and equipment involved in the construction process, plus a contingency allowance for any unexpected expenses which might occur during construction. Cost contingencies of 12 percent have been added to estimated contract costs for all structural measures, except for recreation facilities which include a 5 percent contingency.

Engineering cost is the cost of preparing construction plans for the structural measures. Examples of engineering costs are the direct costs of engineers, geologists, and other technicians for construction surveys and investigations,

-Costs-

soil and foundation drilling and testing, design, and preparation of plans and specifications.

Land rights cost include all expenditures for 1) flowage easements, fee title acquisitions, legal fees, appraisal costs, etc., 2) the closing or modification of private, county or State roads, 3) the purchase or modification of buildings or other improvements, 4) the modification or removal of utility lines, 5) the reconstruction or modification of fences, 6) the weighting, lowering, or rerouting of pipelines, 7) the replacement or extension of bridges, 8) the displacement of historic sites and monuments and 9) the displacement or leveeing of burial sites.

Relocation payments are applicable to a displaced person, business or farm operation. Such payments include compensation for moving and other related expenses incident to relocation, and in certain instances, financial assistance for replacement housing to those displaced persons who qualify.

Project administration costs are the administration costs associated with the installation of structural measures. Included are the costs of relocation assistance advisory services, contract administration, review of engineering plans prepared by others, Government Representatives and construction inspection necessary to insure the installation of structural measures in accordance with plans and specifications. Relocation assistance advisory services are applicable whenever the acquisition of real property for a project measure will result in the displacement of any person, business or farm operation. Services involved include serving notice of displacement providing displacees pamphlets or brochures outlining benefits to which they might be entitled, providing appropriate application forms to displacees, assisting displacees in filing application for relocation payments, providing displacees with current information regarding the availability and location of sale and/or rental property, providing information on State and Federal loan programs offering assistance to displacees, hearing and resolving grievances, and other services to minimize hardships to displacees in adjusting to relocation.

Cost Allocation - Joint installation costs on multiple purpose structures were allocated to purpose by the "Use of Facilities" method. Sediment storage volumes were assigned to the flood prevention purpose in the allocation procedure. Specific costs related to individual structural measures are footnoted on Table 2. Total allocated costs for each structural measure or group of similar measures are given in Table 2A.

Multiple Purpose Structure No. U-1 - Total allocated costs to purpose for multiple purpose structure No. U-1 are \$289,137 to flood prevention, \$1,198,718 to recreation and \$6,075 to industrial water supply. Specific cost items for the structure include \$2,000 construction and \$400 engineering for installation of the specific water supply outlet facilities, \$100 land rights for expenses incurred in obtaining a use permit from the Forest Service for storage of water supply and \$100 land rights for expenses incurred in obtaining a similar use permit for flood prevention storage. Public Law 566 funds will bear only those joint construction and engineering costs on the structure allocated to flood prevention. Such costs are \$251,849 for construction and \$30,222 for engineering.

The U. S. Forest Service will bear those joint construction and engineering

costs on the structure allocated to recreation (\$1,044,490 and \$125,338 respectively) and the entire construction and engineering cost for the recreational development. Those joint construction and engineering costs for the structure allocated to industrial water supply will be borne by the Town of Birdseye (\$5,206 and \$625 respectively), as will the entire construction and engineering cost of the specific water supply outlet facilities.

Land rights costs for the structure will be cost shared as follows.

	<u>Anderson River Cons. District</u> (dollars)	<u>Town of Birdseye</u> (dollars)	<u>U.S. Forest Service</u> (dollars)	<u>Estimated Land Rights Costs</u> (dollars)
Use Permits on U.S. Forest Land	100	100	0	200
Cost of Allocation or Modification of Improvements	<u>6,966</u>	<u>144</u>	<u>28,890</u>	<u>36,000</u>
Total	7,066	244	28,890	36,200

Multiple Purpose Structure U-10 - Total allocated costs to purpose for multiple purpose structure No. U-10 are \$262,134 for flood prevention and \$285,771 for recreation. Land rights are estimated to be \$117,400. Appraisal costs are estimated to be approximately \$750 per tract, of which P.L. 566 funds will bear 50 percent. Public Law 566 funds will bear the entire joint construction and engineering costs on the structure allocated to flood prevention (\$222,361 and \$26,682 respectively), the entire joint engineering cost allocated to recreation (\$17,138), and 50 percent of the joint construction costs allocated to recreation (\$71,412), and 50 percent of all land rights cost allocated to recreation with the exception of \$2,000 legal fees (\$57,700).

Public Law 566 funds for cost sharing on structure land rights will be used in obtaining approximately 274 acres of land, 2 farm dwellings and associated farm buildings and in rerouting approximately 2 miles of local utility lines. In addition, P.L. 566 funds will be used in sharing the expense of relocation payment costs incurred in the displacement of the 2 dwellings and 1 farm operation involved in acquisition of land rights for the structure. Such expenses will be shared in accordance with the ratio of P.L. 566 funds and Other funds to Total Project Costs as shown on Table 1, exclusive of relocation payment costs. This cost share percentage is 41.87 percent P.L. 566 funds and 58.13 percent Other funds (see Work Plan Agreement).

Public Law 566 funds will be used in cost sharing for land and facilities in the recreational development associated with structure No. U-10. Such funds will bear 50 percent of all construction, engineering and land rights cost incurred in the installation of the development, with the exception of \$5,000 of land rights costs for surveying, abstracting and legal fees. Those costs to be borne by P.L. 566 funds are \$268,050 construction, \$18,900 engineering and \$23,400 land rights. Land rights costs shared with P.L. 566 funds include the acquisition cost of approximately 156 acres of land.

All costs for structure No. U-10 and its associated recreational development, other than those to be borne by P.L. 566 funds, will be borne by the Perry County Park and Recreation Board.

-Costs-

Multiple Purpose Structure No. L-24 - Total allocated costs to purpose for structure No. L-24 are \$54,758 flood prevention and \$22,813 municipal water supply. Specific cost items for the structure include \$12,000 construction and \$2,000 engineering for municipal water outlet and pickup facilities. Public Law 566 funds will bear only those construction and engineering costs on the structure allocated to flood prevention. Such costs are \$41,515 for construction and \$4,984 for engineering. The Anderson River Conservancy District will bear all other costs of the structure.

Project Administration Costs - The cost of project administration will be borne by P.L. 566 funds and Other funds in the amounts of \$802,015 and \$241,917 respectively (see Table 2). Of those costs to be borne by Other funds \$164,200 will be borne by the U. S. Forest Service in installing multiple purpose structure No. U-1 recreational development, \$340 will be borne by the Town of Birdseye in installing multiple purpose structure No. U-1 industrial water supply outlet facilities, \$23,195 will be borne by the Perry County Park and Recreation Board in installing multiple purpose structure No. U-10 and its associated recreational development, and \$54,182 will be borne by the Anderson River Conservancy District for installation of all other structural measures.

Costs for relocation assistance advisory services on multiple purpose structure No. U-10 are the responsibility of the Perry County Park and Recreation Board. Such costs are estimated at \$1,500 and are included as a part of the above \$23,195 Park Board project administration cost obligation. The Service through P.L. 566 funds will bear those project administration which they incur in assisting the Perry County Park and Recreation Board discharge its relocation assistance advisory services responsibility and all other project administration costs which they incur during installation of the structural measures.

Schedule of Obligations - The estimated schedule of P.L. 566, U. S. Forest Service and Other fund obligations for the installation of project structural measures is as follows.

Year	P.L. 566	U.S. Forest Service	Other	Total
1	22,786	-	36,450	59,236
2	344,152	-	132,864	477,016
3	317,491	-	48,185	365,676
4	668,735	-	150,741	819,476
5	565,916	154,228	342,999	1,063,143
6	571,800	522,245	62,287	1,156,332
7	587,288	604,345	36,775	1,228,408
8	309,143	492,600	39,654	841,397
9	298,068	492,600	11,282	801,397
10	40,503	-	1,013	41,516
Total	3,725,882	2,266,018	862,250	6,854,150

Non-Project Costs - Should any of the following non-project costs occur, they must be borne by the sponsoring local organizations. These costs are additional items not included in benefit cost, cost allocation, or cost sharing computations.

Non-project costs includes all additional costs resulting from changes of, or additions to, project works of improvement for non-project purposes or

maintenance such as 1) altering a structure to permit its use as a roadway; 2) distributing and leveling spoil or disposing of excavated material primarily to improve land; 3) filling abandoned channels or depressed areas outside of the right-of-way; 4) relocating or modifying planned works of improvement for the convenience of the sponsoring local organizations.

Non-project costs also include costs for land, construction, surveying, engineering, and legal services connected with the installation of water distribution systems for municipal water supply.

EFFECTS OF WORKS OF IMPROVEMENT

Land Treatment

Conservation land treatment measures to be installed in the watershed will reduce annual erosion from an estimated 5.7 tons per acre to 4.4 tons per acre, a 23 percent reduction. Sediment concentrations in watershed stream flows will be reduced in like proportion. Measures to be applied on cropland such as crop residue management, minimum tillage, pasture and hayland planting, grassed waterways, diversions and grade stabilization structures will reduce erosion through interception or reduction of runoff and through stabilization of drainageways. Reduced sheet erosion permits soil fertility to be maintained. A reduction in crop damage associated with poor stands will also result, as will a reduction in permanent land damage caused by gully erosion.

Application of pasture renovation and management practices will improve the overall quality and productivity of approximately 13,210 acres of grassland to be treated. Such areas when properly treated and managed complement the overall farm operation, contributing significantly to farm income with a minimum of erosion risk. Approximately 170 farm ponds will be constructed complementing pasture enterprises and fish and wildlife habitat.

Tree planting on 430 acres of private land and protection of an additional 750 acres of private forest land from grazing will improve hydrologic conditions and thus retard runoff and erosion. Intensified management practices will increase the productivity of an estimated 5,480 acres of private forest land resources and will enhance wildlife and recreation values. Management of public forest land resources for multiple use objectives will contribute to man's enjoyment of nature and the subsequent usefulness of the resources.

Three hundred and ten acres in the watershed having critical erosion problems will be stabilized by planting vegetation such as trees, shrubs, vines, grasses or legumes. This will preserve such areas for future use, enhancing at the same time their natural beauty.

Field border plantings and wildlife habitat management and development will be implemented on 1,038 acres, creating protective cover needed for the perpetuation and increase of wildlife numbers. Critical area plantings, pasture planting, grassed waterways and tree planting contribute to the quantity of protective cover available.

In addition, land treatment will improve the soil environment through a balancing of soil-air-water relationships. Improved crop, pasture, and forest land management practices will enable farmers to achieve a better income balance from their various land use commitments. Pressures to commit watershed land resources in the short run to uses more intensive than are consistent with long run capabilities will be reduced.

Overall effect of the land treatment program on watershed land use will be a reduction of cropland acreage of 7,665 acres, an increase in pastureland acreage of 8,012 acres, an increase in lands managed for forest land purposes of 1,978 acres, and a decrease in land in other uses of 2,325 acres.

Local benefits and significant downstream benefits will accrue from the land

treatment program. Land treatment applied above structural improvements provides the basis for reduced structural cost, improved efficiency of structural operation, and extended structural life. Flood damage throughout watershed flood plain areas will be reduced by an estimated three percent through the land treatment program.

Structural Measures

Flood Prevention, Erosion and Sediment - Expected reductions in flood stages and peak flood discharges attributable to the project are presented in tabular form by evaluation reach (see project map) in the "Hydrology" portion of the "Investigations and Analysis Section" of this plan. Reductions in flood stages are displayed graphically as flood profiles as an attachment to this plan.

Installation of the planned structural measures will produce an overall reduction in evaluated monetary flood damages of 45 percent. This reduction together with the 3 percent reduction accruing through the land treatment program will provide a total damage reduction of 48 percent. Crop and pasture damages will be reduced by 46 percent, other agricultural damaged by 53 percent, road and bridge damages by 64 percent, and flood plain scour by 52 percent. An estimated 120 agricultural landowners in the flood plain will benefit directly from the project. The following table summarizes the expected flood reductions by evaluation reaches.

ACRES FLOODED 1/

Evaluation Reach	Percent Damage Reduction	Average Annual		Annual Flood		10 Year Flood		100 Year Flood	
		Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project
1	0	1,359	1,317	698	697	798	798	846	845
2	26	403	263	167	117	283	243	337	292
2A	34	621	390	347	267	394	325	426	353
3	37	676	392	236	200	315	259	364	309
4	36	591	365	207	177	268	243	422	315
5	32	1,356	866	485	454	654	580	679	648
6	53	885	442	374	235	435	376	473	409
7	71	2,319	745	1,019	371	1,274	919	1,340	1,102
8	61	398	146	151	103	184	141	192	163
9	86	513	87	258	0	294	189	307	244
10	97	134	5	67	0	73	26	77	59
11	59	219	105	105	54	127	73	135	84
12	38	172	106	77	54	104	84	116	93
13	44	170	92	61	47	112	67	149	92
14	100	48	0	30	0	60	0	70	0
15	37	33	23	20	15	30	26	32	30
16	91	159	21	78	0	91	52	103	71
18	53	214	102	96	64	113	95	120	109
19	76	84	26	45	15	54	38	59	47
20	49	651	337	311	166	348	312	368	334
21	31	242	173	89	57	125	109	132	127
22	28	365	276	198	188	206	202	213	207
23	41	187	105	72	52	118	95	145	124
24	37	198	118	71	62	83	73	91	81
25	22	132	106	72	67	83	80	86	84
26	93	66	5	36	0	42	13	45	30
27	65	143	56	52	39	61	49	65	53
28	41	206	120	103	66	162	151	176	165
29	100	16	0	10	0	18	0	31	0
30	99	63	0	39	0	44	0	45	27
40	17	189	189	112	112	200	171	234	206
41	18	131	117	82	62	98	90	111	100
42	13	162	131	61	58	69	66	75	70
TOTAL	48	13,105	7,226	5,829	3,799	7,323	5,945	8,064	6,873

1/ Based on headwater flooding only, does not include backwater effects from the Ohio River.

Benefits resulting from reduced floodwater damages will accrue on 8,064 acres. These benefits will result from reductions in area inundated and reduced flood depths. Based on average values obtained from a weighting of the monthly probability of flood occurrence, estimated future crop and pasture damages of \$207,220 from the 100 year flood event are expected to be reduced to \$155,505, from \$173,784 to \$125,109 for the 10 year flood event, and from \$117,311 to \$67,955 for the annual flood event. Flooding caused by backwater from the Ohio River in the lower reaches of the watershed will not be affected by the project.

Reductions in flood hazards will make it possible for farmers to more fully utilize flood plain land. An estimated 220 acres of such land will be converted from non-cropland uses to cropland as a result of the project. More intensive use of 2,045 acres of flood plain cropland will also result, as farmers increase the level of technology used in the crop production process.

The following table summarizes expected flood plain land use changes. These changes will result in crop and pasture flood damage reductions and account for approximately five percent of project flood prevention benefits.

<u>Land Use</u>	<u>Without Project</u>	<u>With Project</u>
Cropland	6,372	6,592
corn	(3,960)	(4,095)
soybeans	(1,414)	(1,462)
wheat	(358)	(373)
oats	(71)	(73)
hay	(569)	(589)
Pastureland	351	276
Forest land	1,036	891
Other	305	305
Total	8,064	8,064

A significant flood hazard will remain following project installation. Construction of buildings should be discouraged within the 100 year frequency "with project" flood boundary. Flood stages and discharges expected to prevail with project should be considered in the design of roads and bridges in flood plain areas. Flooding in such areas will be reduced, not eliminated. Farm management decisions to intensifying production of agricultural crops should be carefully considered in view of anticipated damage reductions and remaining flood risks.

The trapping effect of detention type storage in planned structures will reduce sediment discharge by approximately 94 percent from the 55.46 square miles of controlled watershed drainage area. Such retention constitutes a 27 percent decrease in sediment concentrations in watershed stream flows. This added to the 23 percent reduction from the planned land treatment program, yields an overall watershed reduction of 50 percent. Such reductions will reduce channel deposition in localized areas, reduce water turbidity throughout the watershed and enhance the aesthetic qualities of water.

Reductions in flooding resulting from the project will reduce scour erosion damages on 369 acres of agricultural flood plain by an estimated 52 percent. Reduced scour will allow for partial recovery of lost productivity on these areas. Points of significant stream bank erosion within the planned channel

-Effects-

work area will be stabilized through removal of flow disrupting obstructions and/or by shaping and riprapping.

The general public will benefit from a reduction in indirect damages. Such benefits will be realized through a reduction in traffic rerouting and work schedule interruptions.

Water Supply - Municipal water stored in structure No. L-24 (120 acre-feet) will provide a dependable water supply for projected growth through the year 2020 at the Saint Meinrad Archabbey. Estimated population for the Abbey at that time is 1,645 persons. Industrial water stored in structure No. U-1 (100 acre-feet) will provide water for potential industrial development at the Town of Birdseye.

Impact of the planned municipal and industrial water supply storage on the economic development of the area will be localized in the communities of Saint Meinrad and Birdseye. Some effect is expected in the surrounding watershed area in helping to utilize underemployed human resources, although its significance is expected to be small.

Fish and Wildlife and Recreation - Permanent pool areas of planned watershed structures will inundate 12.1 miles of perennial warm water stream fishery and 8.5 miles of intermittent feeder streams. Minor disruption of the stream fishery and immediate overbank area will also occur along a 10.5 mile reach of the Anderson River main stem in which channel work is planned. Disruption will be temporary and will result from flow obstructing debris, fallen trees, and trees in danger of falling, being removed from the channel area.

Channels downstream from structures will experience decreased flood flows as a result of the project. Sediment concentrations and attendant nutritive loads of watershed stream flows will be decreased by 50 percent. Base flow of watershed streams is expected to increase. Multilevel gated outlets on multiple purpose structure Nos. U-1 and U-10 will allow for the beneficial regulation of water quality in base flow discharges passed through the structures to downstream fishery areas.

Existing lakes or ponds will not be affected by the project. Wildlife wetland areas are virtually non-existent in the watershed. None are expected to be created through the installation of project structural measures.

No known rare or endangered plant species exist in the watershed. Ecological balance is not expected to change significantly within the project area.

A number of land use changes will occur in areas committed to the installation of structural measures. Current land use within multipurpose structure permanent pool areas (recreation and water supply pools) will be replaced by permanent open water storage. Land use within single purpose structure sediment pool areas will be replaced by sediment throughout the life of the project. An estimated 1,103 acres will be affected involving 616 acres of forest land, 482 acres of cropland and pasture and 5 acres of roads. Dam and emergency spillway areas involving 171 acres will also be subjected to land use changes. These areas, consisting of 95 acres of forest land, 75 acres of crop and pasture land, and 1 acre of roads will be reshaped during construction and permanently vegetated with a mixture of herbaceous and/or woody plantings. Relatively

minor land use conversions will occur in flood pool areas (623 acres). Extent of these changes will be limited to shifts in current cropland areas to pasture use. Planned channel work will not result in any significant land use changes. Approximately 156 acres of land in structure No. U-10 recreational development will be converted to recreation use. This area currently consists of 106 acres forest land, 47 acres pastureland, and 3 acres cropland.

The total effect of installation of all project measures is presented in summary form in the following table.

Land Use		Current Acres	After Without Project Land Treatment (Ac.)	WITH PROJECT <u>1/</u>		
				After Accelerated Land Treatment Application (Ac.)	After Structural Measure Installation (Ac.)	After Flood Plain Land Use Conversion (Ac.)
Cropland		26,241	23,229	18,576	18,152	18,372
Pastureland		22,901	26,050	30,913	30,703	30,628
Forest Land		38,622	39,399	40,600	39,711	39,566
Other Land	Open <u>2/</u> Water	80	80	80	1,183	1,183
	Wildlife & Recreation	1,052	1,705	2,715	2,863	2,863
	Idle and <u>3/</u> Miscellaneous	8,278	6,711	4,290	4,562	4,562
Watershed Total		97,174	97,174	97,174	97,174	97,174

1/ Project effects are cumulative from left to right.

2/ Includes areas greater than 2 acres, does not include streams.

3/ Includes farmsteads, roads, urban areas, strip mines, etc.

Land acquired for multiple purpose structure Nos. U-1 and U-10 and structure No. U-10 recreational facility will provide for public access. Availability of recreation and fish and wildlife resources in these areas to potential users will be expanded. Land used for single purpose flood prevention structures and along the planned channel is expected to remain in private ownership.

Structure Nos. U-1 and U-10 recreational developments will provide opportunities for swimming, picnicking, boating, fishing, camping and nature study during the approximate 200 day recreation season. The recreational development at structure No. U-1 will accommodate approximately 2,000 people on a typical heavy use day. The recreational development at structure No. U-10 will accommodate about 1,800 recreation visits on a typical heavy use day. The estimated annual recreation use at structure No. U-1 is 103,625 recreation visits and 71,500 recreation visits at structure No. U-10. The value of the recreation visit in the economic evaluation of monetary recreation benefits is \$2.25.

Archeological, Historical and Scientific - The Blunk cemetery located in Section 30, T2S, R2W, is located within the proposed permanent pool area of structure No. U-1. The cemetery will be moved to some appropriate location above floodwater elevations in accordance with Indiana law and State Board of Health regulations. Remains of an old grist mill buhr is reported to exist

-Effects-

near the outlet of Mitchel Creek, Section 31, T2S, R2W. An intensive search failed to locate the remains. No other known areas of archeological, historic or scientific interest will be affected by the project. Little archeological surveying has been accomplished.

General - Increased employment opportunities will be made available to local employed and underemployed laborers in project construction and in performing operation and maintenance after project installation, thereby slowing the rate of migration from the watershed. Contractors can be expected to supply most of their needs for unskilled labor for project installation from local sources. Underemployed rural residents constitute the major source of such labor in this area. Project installation will have a direct immediate effect in alleviating local underemployment.

Operation and maintenance of the recreational developments will produce approximately 15 man years of employment annually. While some employment loss can be expected due to the loss of agricultural land in structure and recreational development areas, this will be offset by increased employment because of more intensive use of areas subject to flood hazard reduction. Recreational activity will increase opportunities for local residents to set up associated income producing enterprises such as fish bait, fresh vegetables, handicrafts and riding stables.

The overall watershed economy will experience a general uplift through the secondary impact of the project on local business. This will occur initially through the expansionary effect of construction spending. Realization of primary project benefits such as more intensive use, changed land use and recreation will place increased demands on suppliers of local goods and services and marketing, processing and transportation facilities, thereby sustaining the uplift effect throughout the project life.

Increased vehicular traffic is expected to result in the watershed area as potential recreation users seek available recreational opportunities. Principal access routes to the recreation developments at structure Nos. U-1 and U-10 will be State Road 145 and Interstate Highway 64. Highway maintenance costs to watershed residents should not be affected materially.

Limited incidental recreation use is expected in single purpose flood prevention structure sediment pools. This usage can be expected primarily from adjoining landowners and their guests and will decline as sediment accumulates in the pool areas.

Installation of structure No. U-10 and its associated recreation development will displace two owner occupied dwellings and one farm operation. The sponsors have determined that replacement dwellings and farms are available within the general area. The economic impact of the lost farm operation to businesses or markets in the area will not be significant. Social ties of displaced persons are not expected to be significantly affected.

Combined effects of land use conversions attributable to project land treatment and structural measures will decrease the watershed acreage used in the production of surplus crops. Whereas some agricultural lands will be lost from the tax rolls in structure and recreational development areas, the effect on total tax revenues in the watershed should be temporary. Adjustment of tax

rates in accord with increased earning potentials of watershed areas benefiting from project measures is expected to more than offset revenue losses from such areas removed from taxation.

PROJECT BENEFITS

Total average annual benefits to the project are estimated at \$709,683. This includes offsite damage reduction benefits to land treatment measures of \$4,792 and benefits to structural measures of \$704,891 (Table 6). Onsite conservation benefits to land treatment measures were not evaluated, as the worth of such measures is widely recognized.

Primary flood prevention benefits to structural measures were estimated as follows: damage reduction - \$154,625; more intensive land use - \$14,030; and changed land use - \$8,580. Other primary benefits include recreation - \$394,031; and municipal and industrial water supply - \$6,632 (Table 6).

Damage reduction benefits accruing to the overall project include reduced crop and pasture damage of \$106,667, other agricultural damage reduction of \$27,567, damage reduction to nonagricultural values of \$6,991, reduced flood plain scour damage of \$2,745, and a reduction of indirect flood damage of \$15,447. Benefits of this type total \$159,417 (Table 5) and accrue jointly to the structural and land treatment programs. Evaluation of flood reduction benefits was limited to only those areas affected by project structural measures.

Local secondary benefits to structural measures were estimated at \$126,993 (Table 6). Only benefits generated from additional income by the project through increased demands on local suppliers of goods and services and on local processing, transporting, and marketing facilities were evaluated. Benefits of a secondary nature from a national viewpoint were not considered pertinent and were therefore not evaluated.

COMPARISON OF BENEFITS AND COSTS

Total project benefits to structural measures of \$704,891 annually compared to average annual structural cost of \$484,809 gives an overall benefit cost ratio of 1.5:1.0. The ratio of project benefits to costs, excluding local secondary benefits in the amount of \$126,993, is 1.2 to 1.0.

PROJECT INSTALLATION

Land Treatment Measures

The sponsoring Soil and Water Conservation Districts will assume the responsibility for the application of land treatment measures on private land. Such measures will be installed by landowners and operators within a 10 year period. The Soil Conservation Service will provide personnel to assist the Soil and Water Conservation Districts in providing landowners and operators technical assistance to develop basic conservation plans and to install planned practices. Technical assistance for the woodland measures to be installed on private land will be furnished by the Indiana Division of Forestry in cooperation with the U. S. Forest Service. The U. S. Forest Service will install the land treatment practices on Hoosier National Forest land and the Indiana Department of Natural Resources, Division of Forestry will install such measures on Ferdinand State Forest land.

Structural Measures

All works of improvement will be installed within a ten year period. Land rights will be acquired on structure Nos. L-6, L-13, L-21, and L-30 within the first year. The remaining land rights will be acquired over the next eight years with land for structure No. U-10 and its recreation area being acquired the second year. Actual alterations of roads, cemeteries, power lines, and telephone lines may take place prior to or concurrently with construction of the structural measures involved.

Grouping of several small structures into one contract is planned in an effort to 1) reduce the total number of contracts involved, 2) to create an efficient contract unit for bidding, and 3) to more efficiently utilize contracting and inspection personnel. Structure groupings were based on intra-group access and total contract cost. The following yearly construction sequence for the project installation period was selected to involve the whole watershed in construction activities at an early date and to complete structural control on subwatersheds as soon as possible.

Item

- | | | |
|------|----|---|
| Year | 1. | Land rights for structure Nos. L-6, L-13, L-21, and L-30. |
| | 2. | Construction of structure Nos. L-6, L-13, L-21, and L-30; land rights for structure Nos. U-6, U-7, U-8, U-37, and U-38; land rights for structure No. U-10 and its associated recreational development. |
| | 3. | Construction of structure Nos. U-6, U-7, U-8, U-37, and U-38; land rights for structure Nos. L-48, L-50, L-51, L-52, L-53, L-54, L-56, and L-59. |
| | 4. | Construction of structure No. U-10; construction of structures Nos. L-48, L-50, L-51, L-52, L-53, L-54, L-56, L-59; land rights for structure Nos. L-37, L-38, L-39, and L-40. |
| | 5. | Construction of structure No. U-10 recreational facility; construction of structure Nos. L-37, L-38, L-39, and L-40; land rights for |

structure Nos. L-5, L-7, L-17, L-18, and L-55; land rights for structure No. L-24 with municipal water supply features; land rights for structure No. U-1 and its associated recreational and industrial water supply features.

6. Construction of one-half of structure No. U-1; construction of structure No. L-24 with municipal water supply features; construction of structure Nos. L-5, L-7, L-17, L-18, and L-55; land rights for structure Nos. U-4, U-17, U-34, U-35, and U-36.
7. Construction of one-half of structure No. U-1; construction of structure Nos. U-4, U-17, U-34, U-35, and U-36; land rights for structure Nos. L-35, L-36, L-45, L-46, L-26, L-29, and L-32.
8. Construction of one-half of structure No. U-1 recreational facilities; construction of structure Nos. L-35, L-36, L-45, L-46, L-26, L-29, and L-32; land rights for structure Nos. U-18, U-19, U-20, U-31, U-12, U-28, U-29, and U-30.
9. Construction of one-half of structure No. U-1 recreational facilities; construction of structure Nos. U-18, U-19, U-20, U-31, U-12, U-28, U-29, and U-30; land rights for channel work.
10. Channel work.

The Anderson River Conservancy District is a sponsoring local organization qualified under State law to carry out the works of improvement outlined in this work plan. The Conservancy District has the power of eminent domain and taxation, as provided by the Indiana Conservancy Act, and will use this power as necessary to assure scheduled completion of their portion of the project. The Conservancy District will be responsible for securing land rights and administering all structure and channel work contracts except for structure Nos. U-1 and U-10. The Conservancy District will also be responsible for providing all construction and engineering costs allocated to municipal water supply for structure No. L-24. The engineering design for structure No. L-24 and its associated outlet facility will be provided through a negotiated A and E Contract.

The Perry County Park and Recreation Board will be responsible for securing the land rights and administering all contracts for structure No. U-10 and its associated recreational facility, and will provide the local share of construction and engineering costs for the recreation purpose. The Board has the power of eminent domain and taxation as provided by the Indiana Park and Recreation Law of 1965 and will use this power as necessary to assure the scheduled completion of the project. Engineering design for the structure will be provided by the Service and for the recreational facility through a negotiated A and E contract.

As part of project administration, the Park Board will provide such relocation assistance advisory services as may be needed in connection with the displacement of two dwellings and one farm operation in the structure and associated recreational development area. These services include serving written notice of displacement, providing displacees pamphlets or brochures outlining benefits to which they might be entitled, providing appropriate application forms to displacees, assisting displacees in filing application for relocation payments, providing displacees with current information regarding the availability and location of sale and/or rental property, providing information on State

-Installation-

and Federal loan programs offering assistance to displacees, hearing and resolving grievances, and other services to minimize hardships to displacees in adjusting to relocation. The sponsors have determined that decent, safe, and sanitary housing will be available to all persons displaced by the project. Displaced persons will be given notice to vacate at least 90 days before they are required to move.

The Service will be responsible for the design and administration of all contracts for structure No. U-1 with the exception of that portion pertaining to the specific water supply outlet facilities. Design and contract administration responsibilities for these water supply features will be borne by the Town of Birdseye. As a part of project administration the Service will assist the Park Board in fulfilling their responsibility. The U. S. Forest Service will be responsible for the design, administration of contracts, and all costs associated with structure No. U-1 recreational development.

Land rights for the structure will be provided by the U. S. Forest Service, except for the cost which local sponsors will incur in obtaining use permits from the Forest Service, and those local costs associated with the moving of approximately 70 graves and 3 miles of telephone line from structure pool areas. The Anderson River Conservancy District will assume the responsibility for securing the use permit for installation, operation and maintenance of flood prevention features of the structure, and for carrying out the relocation of graves and the telephone line. The Forest Service and the Town of Birdseye will transfer funds to the Conservancy District for those land rights costs which they will incur in achieving these relocations (see project agreement). The Town of Birdseye will assume responsibility for obtaining a use permit for water supply features of the structure.

The Service will assume the following responsibilities in addition to those stated above: 1) engineering design and all construction costs for single purpose flood prevention structural measures; 2) all construction costs for recreation to be borne by P.L. 566 funds in structure No. U-10 and its associated recreational development; and 3) administrative functions on all structural measures except structure No. U-1 recreational development. Such administrative functions include the review of engineering plans prepared by others, construction layout and inspection, and consultive assistance to others during contracting and construction. As a part of its administrative functions, the Service will assist project sponsors in fulfilling their relocation assistance advisory services responsibilities.

The Department of Natural Resources, State of Indiana, in accordance with State laws and regulations will review and approve the plans and specifications for the structural works of improvement to be constructed.

Land rights may be acquired through donation, a mutual agreement to exchange, negotiation of purchase price, or condemnation will be appraised by a qualified land appraiser and a prompt offer made in writing for each tract at no less than full appraised value. Based on information from the Corps of Engineers and past SCS experience, appraisal costs are estimated at \$750 per tract.

FINANCING PROJECT INSTALLATION

Land Treatment Measures

Federal assistance for carrying out the works of improvement set forth in this plan will be provided under authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83d Congress, 68 Stat. 666) as amended. Federal financial assistance is contingent on the appropriation of funds to carry out this plan.

Technical assistance for installation of all accelerated land treatment on cropland, pastureland and other land areas will be provided by the Service through P.L. 566 funds. Cost sharing for installation of these land treatment measures will be provided to landowners and operators through state and federal funds provided under authorities other than P.L. 566. Farm owners and operators will provide the funds for their share of the installation costs of land treatment measures included in this plan. Loans are expected to be available to landowners from banks, the Production Credit Association, the Farmers Home Administration, and business establishments providing goods and services.

Technical assistance for installation of all forest land treatment measures is estimated to be \$52,000 and will be financed in the following manner: \$26,800 under P.L. 566; \$4,400 as the state's share of P.L. 566 accelerated program; and \$20,800 under the going Cooperative Forest Management Program. The installation cost of applying land treatment on private forest land is \$43,700 and will be borne by the landowners and operators in the same fashion as other land treatment programs. The U. S. Forest Service will provide \$900 from regular appropriations for the installation of forestry measures on National Forest land. The Indiana Department of Natural Resources, Division of Forestry, will provide \$10,400 from regular appropriations for the installation of land treatment measures on State Forest land.

Structural Measures

All necessary land rights for a particular structural measure will be secured before federal financial assistance is made available for the installation of that structural measure. These land rights include, but are not limited to agreements with county and State road officials concerning modifications to roads, and fee simple title or easements on land and improvements as required.

The sponsoring local organizations have analyzed their financial needs in consideration of the scheduled installation of the works of improvement and have made provisions for the ways and means of obtaining the necessary funds. The Anderson River Conservancy District has filed a letter of intent with the Farmers Home Administration stating their desire to obtain a loan to help finance their share of initial project costs. The Town of Birdseye has the necessary available finances to cover their water supply portion of structure No. U-1 costs.

The U. S. Forest Service will finance its obligation for structure No. U-1 and the associated recreational development as the work qualifies for financing under the development program for the National Forest System and as funds are appropriated. Forest Service participation will depend upon line item appropriations for all project related costs.

-Financing-

The Perry County Park and Recreation Board plans to use a grant from the Department of Natural Resources for financing that portion of the construction cost and land rights cost of structure No. U-10 allocated to recreation. Park Board funds will be used for their share of the recreational facilities costs including the cost of land rights, construction, engineering, relocation payments, and relocation assistance advisory services. Such facilities will be financed initially with anticipated proceeds from a \$303,425 loan through the Farmers Home Administration. A letter of intent has been filed by the Park Board with the State Director of the Farmers Home Administration to establish a line of credit. The Park Board anticipates the repayment of loan proceeds through funds from taxation, gifts, donations, grants, and from user fees. User fee charges will be comparable to those on similar State owned facilities.

The annual income from the use of the recreational facilities is estimated as follows:

1. Camping fees	\$ 9,075.00
2. Boat launchings	2,700.00
3. Gate admissions	9,260.00
4. Beach admissions	13,400.00
5. Concessions and vending machines	<u>3,150.00</u>
Total	\$37,585.00

User fees will not exceed those required to amortize the initial investment and provide for operation and maintenance.

Invitation to bid on construction of each planned structural measure will be issued after the project agreement is executed. This agreement will be executed when Public Law 566 funds have been appropriated; the contracting agencies have funds available and are prepared to discharge their responsibilities; the necessary land rights have been obtained; the required land treatment in the drainage area above the structural measures has been installed; the construction plans and specifications have been prepared and approved as required; and the operation and maintenance agreements have been executed.

Prior to entering into agreements that obligate funds of the Service, the sponsors will have a financial management system for control, accountability, and disclosure of P.L. 566 funds received, and for control and accountability for property and other assets purchased with P.L. 566 funds.

Program income earned during the grant period will be reported on the sponsor's request for advance or reimbursement from the Service.

PROVISIONS FOR OPERATION AND MAINTENANCE

An establishment period is prescribed to allow time for latent defects and design deficiencies to become apparent. The establishment period for structural works of improvement shall extend three years from the date the structural works of improvement are accepted from the contractor as being completed. The establishment period for vegetative work associated with a structural measure is to terminate when any of the following conditions are met:

- a. Adequate vegetative cover is obtained.
- b. Two growing seasons have elapsed after initial installation of vegetative work.
- c. The establishment period for the associated structural measure has terminated.

During the establishment period for vegetative measures, the State Conservationist may approve federal cost sharing for any additional work required to obtain an adequate vegetative cover. Approval of the administrator is required for federal cost sharing for other repair or additional work on completed structural works of improvement.

Land treatment measures will be operated and maintained by the owners and operators of the farms under agreement with the local Soil and Water Conservation Service. The forest land treatment measures installed on private land will be maintained by the landowners with technical assistance furnished by the Indiana Department of Natural Resources, Division of Forestry, in cooperation with the U. S. Forest Service under the going Cooperative Forestry Programs. The U. S. Forest Service and the Indiana Department of Natural Resources, Division of Forestry, will maintain land treatment measures installed on the Hoosier National Forest and the Ferdinand State Forest respectively.

All structures are designed for automatic discharge of floodwater. The Conservancy District will insure the principal spillways are kept free of obstructions so the system will function as designed. Average annual operation and maintenance cost for each of the single purpose structures was set at \$75.

The operation of structure No. U-1 and its associated recreational facility will be the responsibility of the Forest Service. An operations agreement will be executed between the Forest Service and the Town of Birdseye for the industrial water supply features. It will include measurement and scheduled release of water. Average annual operation and maintenance cost for the structure and associated water supply feature is \$845.

Funds for the operation and maintenance of the structure and recreational facility will be obtained by user fees where allowed by law. Other funds will come from the Forest Service's regular operating budget. Complete replacement of the recreational facilities is not expected as the Forest Service stresses yearly maintenance and upkeep once such facilities are established. Average annual operation and maintenance cost for the recreational facilities is \$25,620.

The Perry County Park and Recreation Board will be responsible for the operation

-Operation and Maintenance-

of structure No. U-10 and the associated recreational facilities. They will also be responsible for implementing such zoning regulations as are necessary to avoid conflict among the various recreational activities. The average annual operation and maintenance costs for the structure and associated recreational facilities are \$640 and \$46,772 respectively.

The estimated replacement interval for items needing periodic replacement is as follows: garbage cans, 5 years; road and parking lot surfaces, 10 years; signs, playground equipment and picnic tables, 17 years; fences, grills, sewage treatment plant and lift station, diving towers and boat docks, 25 years; and buildings 50 years.

Funds for operation and maintenance of the structure and recreational facilities will be obtained by user fees and through taxation. User fees will not exceed that required to amortize the initial investment and provide for operation and maintenance. These fees will be comparable to those being charged at State owned facilities of similar quality.

The Anderson River Conservancy District will be responsible for the operation of structure No. L-24, which includes water supply for the Saint Meinrad Archabbey. An agreement will be executed between the District and the Archabbey concerning the release of the water. Water supply storage will be released through a gated outlet on the structure principal spillway. Such water will flow down the natural channel to a pick up station from which it will be piped to the treatment plant. Funds for the operation of the water supply features will be obtained from the sale of water. (29) Average annual operation and maintenance cost for the structure and associated water supply feature are \$250 and \$1,920 respectively.

The operation and maintenance work will consist of such items as:

- a. Repairing damage to structural embankments and spillways.
- b. Mowing grass on embankments and emergency spillways.
- c. Removing trash from the permanent pools.
- d. Removing trash and debris from the channel as required to minimize bank erosion and maintain channel capacity.
- e. Providing operation personnel and equipemnt for public facilities.
- f. Repairing and replacing facilities.

The mowing operations will be performed in late summer or fall to minimize wildlife cover disturbance.

Average annual operation and maintenance cost for the channel is estimated to be \$1,260.

Inspections of the single purpose floodwater retarding reservoirs will be made by representatives of the Conservancy District and the Soil Conservation Service. On structure No. U-1 the inspections will be conducted by the Conservancy District, Soil Conservation Service and U. S. Forest Service, and on structure No. U-10 they will be made by the District, Service, and the Perry County Park

and Recreation Board. Inspections of the channel will be made by the District and the Service. Representatives of the Indiana Department of Natural Resources and U. S. Fish and Wildlife Service will also be invited to participate in annual inspections. Land treatment measure inspections will be the responsibility of the landowners. Inspections will be made annually, after unusually severe floods, and after the occurrence of any other unusual conditions that may adversely affect the works of improvement. Authorized persons will have free access for inspections. These joint inspections will continue for at least three years following the installation of each structural measure.

Inspection will note unsightly and damaging erosion, sediment and debris accumulation, and will include such items as the condition and proper functioning of the concrete work, earth fills, principal and emergency spillways, gates and valves, vegetative growth, channel banks and bottoms, and bridge abutments.

Inspection reports indicating maintenance needed will be jointly prepared by the members of the inspection team. A copy will be furnished to each organization or agency participating in the inspection. Follow-up reports will be prepared at regular intervals until all deficiencies noted in the inspection report have been satisfactorily corrected.

Private bridges and facilities of public utilities will be operated, inspected and maintained by the respective owners. All other bridge maintenance will be handled by officials responsible for such maintenance from funds appropriated for that purpose.

Specific operation and maintenance agreements will be executed between the Service and the sponsor responsible for any structural measure, prior to signing a land rights or project agreement. The Service's Indiana Watershed Operation and Maintenance Handbook will be referenced in the operation and maintenance agreements. The sponsor responsible for a particular structural measure will, in conjunction with the Service, prepare an operation and maintenance plan for that measure.

The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with P.L. 566 financial assistance.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Anderson River Watershed, Indiana

Installation Cost Item	Unit	Number		ESTIMATED COST (DOLLARS) 1/										Sub- Total Other	TOTAL		
				P.L. 566 Funds				Sub- Total		Other Funds							
				Fed. Land		Non-Fed. Land		Federal Land		Non-Federal Land		Federal Land				Non-Federal Land	
				SCS 2/	FS 2/	SCS 2/	FS 2/	SCS 2/	FS 2/	SCS 2/	FS 2/	SCS 2/	FS 2/				
LAND TREATMENT																	
Land Areas																	
Cropland	Ac.	10,737														777,103	
Pastureland	Ac.	18,002														1,176,875	
Forest Land	Ac.	10,460														55,100	
Other Land	Ac.	3,313														69,925	
Technical Assistance																220,400	
TOTAL LAND TREATMENT	Ac.	42,512														2,999,403	
STRUCTURAL MEASURES																	
Construction																	
Floodwater Retarding Structures	No.	2	44													1,645,401	
Multiple Purpose Structures	No.	1	2													1,725,541	
Recreation Facil.	No.	1	1													1,357,850	
M & I Outlet Fac.	No.	1	1													14,000	
Channel Work (N) 2/	Mi.		10.5													33,753	
Subtotal Constr.																	
																4,776,545	
Engineering Services																	
Relocation Payments																530,863	
Project Administration																	
Constr. Inspection																	
Other																545,753	
Relocation Assistance, Advisory Services																495,179	
Other Costs																3,000	
Land Rights																	
TOTAL STRUCTURAL MEASURES																	
																4,81,310	
TOTAL PROJECT																	
																9,853,553	

1/ Price base 1973

2/ Federal agency responsible for assisting in installation of works of improvement.

3/ Prior to project, this was an unmodified, well defined natural stream.

The planned trash and debris removal will not materially change its natural condition.

July 1975

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(At time of Work Plan Preparation)

Anderson River Watershed, Indiana

Measures	Unit	Applied To Date	Total Cost (Dollars)
<u>LAND TREATMENT</u>			
Soil Conservation Service			
Conservation Cropping System	Acres	5,205	9,733
Contour Farming	Acres	1,078	2,207
Crop Residue Management	Acres	4,578	7,142
Critical Area Planting	Acres	3	300
Diversions	Feet	68,458	21,222
Drainage Field Ditch	Feet	11,500	2,070
Drainage Main or Lateral	Feet	92,223	57,178
Drains	Feet	839,769	520,658
Grade Stabilization Structure	Number	56	35,000
Grassed Waterways	Acres	168	58,800
Minimum Tillage	Acres	413	1,420
Open Channel	Feet	34,537	38,681
Pasture Management	Acres	2,269	68,070
Pasture Planting	Acres	7,691	615,280
Pond	Number	351	351,000
Spring Development	Number	9	5,512
Stripcropping	Acres	40	150
Terraces	Feet	23,684	5,921
Wildlife Habitat Management	Acres	255	9,562
Forest Service			
Fire Control	Acres	42,430	42,400
Hydrologic Cultural Operations	Acres	2,478	26,900
Management Plans	Number	112	6,200
	Acres	5,913	
Tree Planting	Acres	2,278	120,900
Woodland Grazing Control	Acres	4,032	33,900
	Mi. of Fence	32	
TOTAL	: : : : : :	: : :	2,040,206

Price Base: 1973

July 1975

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Anderson River Watershed, Indiana

(Dollars) 1/

Item	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds				Total		
	Constr.	Engrg.	Land Rights	Reloc. Pymts.	Total P.L. 566	Constr.	Engrg.	Land Rights	Reloc. Pymts.	Total Other	Inst. Cost
(Floodwater Retarding Structures)											
Upper Main Above Hwy. No. 62)											
U-4	81,455	9,775			91,230			5,200		5,200	96,430
U-6	34,318	4,118			38,436			3,640		3,640	42,076
U-7	30,835	3,700			34,535			2,400		2,400	36,935
U-8	25,197	3,024			28,221			1,450		1,450	29,671
U-17	37,813	4,538			42,351			4,000	2/	4,000	46,351
U-18	30,893	3,707			34,600			100		100	34,700
U-19	21,254	2,550			23,804			1,580		1,580	25,384
U-20	32,353	3,882			36,235			1,780		1,780	38,015
U-34	35,775	4,293			40,068			4,260		4,260	44,328
U-35	37,535	4,504			42,039			2,950		2,950	44,989
U-36	43,849	5,262			49,111			4,640		4,640	53,751
U-37	56,066	6,728			62,794			7,480		7,480	70,274
U-38	59,396	7,128			66,524			100	2/	100	66,624
Subtotal	526,739	63,209			589,948			39,580		39,580	629,528
(Upper Main below Hwy. No. 62 to Hurricane Creek)											
U-12	36,289	4,355			40,644			19,570	3/	19,570	60,214
U-28	27,102	3,252			30,354			2,410		2,410	32,764
U-29	30,031	3,604			33,635			2,400		2,400	36,035
U-30	37,360	4,483			41,843			3,000		3,000	44,843
U-31	29,735	3,568			33,303			1,820		1,820	35,123
Subtotal	160,517	19,262			179,779			29,200		29,200	208,979

Sheet 1 of 4
July 1975

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Anderson River Watershed, Indiana

(Dollars) 1/

Installation Cost - P.L. 566 Funds						Installation Cost - Other Funds			Total		
Item	Const.	Engrg.	Land Rights	Reloc. Pymts	Total P.L. 566	Constr.	Engrg.	Land Rights	Reloc. Pymts	Total Other	Inst. Cost
(Floodwater Retarding Structures (Cont.))											
(Hurricane Creek System)											
L-5	31,245	3,749			34,994			1,760		1,760	36,754
L-6	32,022	3,843			35,865			1,650		1,650	37,515
L-7	37,124	4,455			41,579			3,340		3,340	44,919
L-13	32,016	3,842			35,858			1,200		1,200	37,058
L-17	27,132	3,256			30,388			2,620		2,620	33,008
L-18	29,807	3,577			33,384			1,950		1,950	35,334
L-21	39,508	4,711			44,219			11,400		11,400	55,619
L-26	23,270	2,792			26,062			2,110		2,110	28,202
L-29	29,627	3,555			33,182			2,400		2,400	35,582
L-32	53,421	6,111			59,532			2,400		2,400	62,232
L-55	53,479	6,417			59,896			25,660	1/	25,660	85,556
Subtotal	388,651	46,638			435,289			56,520		56,520	491,809
(Blackhawk Branch System)											
L-48	32,340	3,881			36,221			7,500		7,500	43,721
L-50	27,197	3,264			30,461			2,060		2,060	32,521
L-51	31,600	3,792			35,392			3,000		3,000	38,392
L-52	32,506	3,901			36,407			10,400		10,400	46,807
L-53	23,797	2,845			26,642			4,020		4,020	30,662
L-54	29,704	3,564			33,268			7,110		7,110	40,378
L-56	21,253	2,550			23,803			3,480		3,480	27,283
L-59	24,160	2,899			27,059			4,440		4,440	31,499
Subtotal	222,467	26,696			249,163			42,010		42,010	291,173

Sheet 2 of 4

July 1975



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Anderson River Watershed, Indiana

(Dollars) $\frac{1}{-}$

Item	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds				Total Inst. Cost	
	Constr.	Engrg.	Land Rights	Reloc. Pymts.	Total P.L. 566	Constr.	Engrg.	Land Rights		Reloc. Pymts.
(Floodwater Retarding Structures (Cont.))										
(Lower Main below Blackhawk Branch)										
L-30	86,330	10,360			96,690			22,200		22,200
L-35	36,404	4,368			40,772			7,230		7,230
L-36	27,375	3,285			30,662			2,740		2,740
L-37	32,502	3,900			36,402			7,400		7,400
L-38	19,650	2,358			22,008			1,800		1,800
L-39	36,795	4,415			41,210			8,800		8,800
L-40	44,950	5,394			50,344			24,800 ^{5/}		24,800
L-45	22,900	2,748			25,648			2,000		2,000
L-46	40,121	4,815			44,936			6,000		6,000
Subtotal	347,027	41,643			388,670			82,970		82,970
NP Structures										
U-1	251,849	30,222			282,071	1,040,696	125,963	36,200 ^{6/}		1,211,859
M&I Outlet Fac.						2,000	400			2,400
Rec. Fac.						821,000	82,100			903,100
U-10	293,773	43,820 ^{8/}	57,700 ^{8/}	9,002	404,295	71,412		59,700 ^{7/}	12,498	517,505
Rec. Fac.					310,350	268,800	18,500 ^{9/}	38,400 ^{10/}		326,100
L-24	41,515	4,984			46,499	17,296	2,076	11,700		31,072
M&I Outlet Fac.						12,000	2,000			14,000
Channel Work (N) ^{11/}										
Main Channel	33,753	4,050			37,803			3,930		3,930
TOTAL	2,534,341	299,424	81,100	9,002	2,923,867	2,242,204	231,439	400,210	12,498	2,886,351
Project Admin.					802,015					241,917
GRAND TOTAL										3,128,268
										6,854,150

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Anderson River Watershed, Indiana

1/	Price Base 1972.
2/	Cost for a "USE PERMIT" on U.S. Forest Service land.
3/	Includes \$10,000 for raising gravel road.
4/	Includes \$12,000 for raising gravel road and \$4,000 for house.
5/	Includes \$12,400 for road modification.
6/	Includes \$200 for "USE PERMIT" on U.S. Forest Service land (\$100 water supply and \$100 flood control), \$21,000 for 70 grave displacements and \$15,000 for 3 miles of telephone line modification.
7/	Includes \$2,000 legal fees, \$9,000 for buildings, \$2,500 for utility line modification.
8/	Includes \$9,000 for buildings, and \$2,500 for utility line modification.
9/	A & E Engineering contract cost shared: \$18,900 for P.I. 544 funds and \$18,000 for Other funds.
10/	Includes \$5,000 for legal fees.
11/	This is an unmodified, well defined, natural channel.

Sheet 4 of 4
July 1975

TABLE 2A - COST ALLOCATION AND COST SHARING
Anderson River Watershed, Indiana
(Dollars) 1/

Item	COST ALLOCATION				COST SHARING							
	Purpose				P.L. 566 Funds				Other Funds			
	Flood Prevention	Recreation	Municipal Water	Total	Flood Prevention	Recreation	Municipal Water	Total	Flood Prevention	Recreation	Municipal Water	Total
Structures Floodwater Retarding, 146	2,093,129			2,093,129	1,842,819			1,842,819	250,280			250,280
	289,137	1,108,718	4,075	1,401,930	282,071			282,071	7,066	1,198,718	6,075	1,211,859
		903,100		903,100						903,100		903,100
			2,400	2,400							2,400	2,400
MP Str. U-10	262,124	285,771		547,895	251,524	116,771		408,295	7,610	136,000		143,610
Rec. Facilities		636,450		636,450		210,250		210,250		326,100		326,100
MP Str. L-24	54,758		22,813	77,571	14,100			14,100	8,259		22,813	31,072
M & I Outlet Fac.			14,000	14,000							14,000	14,000
Channel	41,733			41,733	27,803			27,803	2,930			3,930
GRAND TOTAL	2,740,891	3,024,030	145,288	5,810,218	2,463,746	140,121		2,623,867	277,145	2,563,918	45,288	2,886,351

1/ Price Base 1972

July 1975

TABLE 2B - RECREATIONAL FACILITIES

ESTIMATED CONSTRUCTION COSTS

FOR M. P. STRUCTURE NO. U-1

Anderson River Watershed, Indiana

(Dollars) 1/

Item <u>2/</u> <u>3/</u>	Number	Estimated Unit Cost	Total Constr. Cost
Beach and Bathhouse (850 PAOT)	1	212,500	212,500
Parking (190 cars)	1	57,000	57,000
Entrance Station, landscaping, etc.	Lump Sum	5,000	5,000
Camping Units	20	1,300	26,000
Group Picnic Site (75 PAOT)	1	30,000	30,000
Picnic Units	20	975	19,500
Boat Ramp (75 feet wide)	1	35,000	35,000
Fishermen Parking Lot (20 cars)	1	6,000	6,000
Parking (100 cars w/trailers)	1	60,000	60,000
Sewage System	Lump Sum	35,000	35,000
Water System	Lump Sum	35,000	35,000
Two-way Black Topped Road	3 miles	100,000	300,000
TOTAL			\$821,000

1/ Price Base 1973.

2/ To be constructed by U. S. Forest Service.

3/ The cost of sanitary facilities is included in each item pertaining to public use.

July 1975

TABLE 2B - RECREATIONAL FACILITIES
ESTIMATED CONSTRUCTION COSTS
FOR M.P.P. STRUCTURE NO. U-10

Anderson River Watershed, Indiana

(Dollars) 1/

Item	Number	Estimated Unit Cost	Total Constr. Cost
<u>General</u>			
Boundary Fence	4150 L.F.	1.20	4,980.00
Signs	1 Lump	1,200.00	1,200.00
Grading & Seeding	50 Acres	168.00	8,400.00
Trees and Shrubs	1 Lump	3,600.00	3,600.00
Gate House	1 Lump	4,200.00	4,200.00
<u>Observation Area</u>			
Roads 20' Stone	650 L.F.	7.20	4,680.00
Parking - Stone - 45 Cars	10,800 S.F.	.48	5,180.00
Refuse Stations	2 Ea.	50.00	100.00
<u>Roads</u>			
Main Entrance Road 24'	1,300 L.F.	8.64	11,230.00
Road to Picnic Area No.4 - 20'	3,100 L.F.	7.20	22,320.00
Road to Campground 20'	900 L.F.	7.20	6,480.00
Blacktop to all Roads	1 Lump	13,800.00	13,800.00
Stream Crossing	1 Lump	3,600.00	3,600.00
<u>Campground</u>			
Roads in Campground 12'	2,850 L.F.	4.32	12,310.00
Blacktop for Road	1 Lump	4,100.00	4,100.00
Trailer Spurs 12 x 50 Stone	3,000 L.F.	4.32	12,960.00
Campground Building (Flush Toilets & Central Showers)	1 Lump	16,800.00	16,800.00
Picnic Tables	60 Ea.	48.00	2,880.00
Grills	60 Ea.	48.00	2,880.00
Refuse Station	30 Ea.	36.00	1,080.00
Campground Water System	4,000 L.F.	1.20	4,800.00
Water System	30 Ea.	60.00	1,800.00
Electrical System	60 Outlets	120.00	7,200.00
Sanitary Dumping Station	1 Lump	600.00	600.00
Playground Equipment	1 Lump	2,400.00	2,400.00
<u>Boating</u>			
Boat Ramp & Pier	1 Lump	1,800.00	1,800.00
Boat Docks	18 Docks	144.00	2,590.00
Parking - Stone - 30 Cars & 20 Boat Trailers (Includes turn loops, etc.)	22,600 S.F.	.48	10,850.00
Refuse Station	1 Ea.	40.00	40.00
Water Station	1 Ea.	300.00	300.00

TABLE 2B - RECREATIONAL FACILITIES

ESTIMATED CONSTRUCTION COSTS

FOR M. P. STRUCTURE NO. U-10

Anderson River Watershed, Indiana

(Dollars) 1/

Item	Number	Estimated Unit Cost	Total Constr. Cost
<u>Picnic Area No. 1</u>			
Shelter House	1 Lump	7,200.00	7,200.00
Flush Toilets	1 Lump	7,200.00	7,200.00
Picnic Tables	20 Ea.	42.00	960.00
Refuse Station	4 Ea.	36.00	140.00
Water Station	1 Ea.	300.00	300.00
Grills	3 Ea.	48.00	140.00
Parking - 25 Car Lot & 6 Car Lot (Includes 16' Roadway x 400 L.F.)	16,000 S.F.	.48	7,680.00
<u>Picnic Area No. 2</u>			
Picnic Tables	12 Ea.	48.00	580.00
Refuse Station	2 Ea.	36.00	70.00
Grills	3 Ea.	48.00	140.00
Water Station	1 Ea.	300.00	300.00
Parking - Stone - 20 Cars	4,800 S.F.	.48	2,300.00
<u>Picnic Area No. 3</u>			
Picnic Tables	20 Ea.	48.00	960.00
Refuse Station	4 Ea.	36.00	140.00
Grills	5 Ea.	48.00	240.00
Water Station	1 Ea.	300.00	300.00
Parking - Stone - 20 Cars	4,800 S.F.	.48	2,300.00
Playground Equipment	1 Lump	3,000.00	3,000.00
<u>Picnic Area No. 4</u>			
Shelter House w/Toilets	1 Lump	15,000.00	15,000.00
Picnic Tables	20 Ea.	48.00	960.00
Refuse Stations	3 Ea.	36.00	110.00
Grills	3 Ea.	48.00	140.00
Water Station	1 Ea.	300.00	300.00
Parking Lot - Stone - 20 Cars	4,800 S.F.	.48	2,300.00
Playground Equipment	1 Lump	3,000.00	3,000.00
<u>Swimming</u>			
Bathhouse	1 Lump	30,000.00	30,000.00
Sand Beach	40,000 S.F.	.60	24,000.00
Diving Tower	1 Lump	6,000.00	6,000.00
Guard Chairs	2 Ea.	360.00	720.00
Benches (Concrete)	6 Ea.	60.00	360.00
Boundary Markers	1 Lump	1,200.00	1,200.00
Beach Fence	600 L.F.	4.20	2,520.00
Parking - Stone - 80 Cars	19,200 S.F.	.48	9,220.00

TABLE 2B - RECREATIONAL FACILITIES
ESTIMATED CONSTRUCTION COSTS
FOR M. P. STRUCTURE NO. U-10

Anderson River Watershed, Indiana

(Dollars) 1/

Item	Number	Estimated Unit Cost	Total Constr. Cost
<u>Trails</u>			
Nature Trail	1 Lump	1,200.00	1,200.00
Foot Path to Campground	1,000 L.F.	.60	600.00
<u>Sewage System</u>			
8" Sewers	4,100 L.F.	4.80	19,680.00
Manholes	19 Ea.	432.00	8,210.00
Sewage Lift Station	1 Lump	9,600.00	9,600.00
Force Main 4"	1,000 L.F.	2.28	2,280.00
Treatment Plant	1 Lump	36,600.00	36,600.00
<u>Water System</u>			
Water Main 4"	31,600 L.F.	2.16	68,260.00
Water Main 2"	2,900 L.F.	1.56	4,520.00
Water Lines 1"	650 L.F.	1.08	700.00
Meter Connection	1 Lump	660.00	660.00
<u>Rock Excavation</u>			
Underground Utilities	3,000 C.Y.	18.00	<u>54,000.00</u>
	Subtotal		511,250.00
	Construction Contingencies		
	5%		<u>25,600.00</u>
	TOTAL		536,850.00

1/ Price Base 1973

Sheet 3 of 3
July 1975

TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Anderson River Watershed, Indiana

ITEM	UNIT	U-1	U-4	U-6	U-7	U-8	Structures U-10	U-12	U-14	U-18	U-19	U-20	U-28
Class of Structure													
Drainage Area	Sq. Mi.	13.73	1.09	0.83	0.36	0.38	8.93	1.14	0.72	0.42	0.30	0.35	0.47
Curve No. (1-day)(AMC II)		80	80	80	80	80	80	80	80	80	80	80	80
Tc	Hrs.	1.50	0.8	0.6	0.4	0.3	2.8	0.7	0.4	0.4	0.3	0.4	0.3
Elevation Top of Dam	Ft.	566.6	505.1	574.6	535.9	567.2	509.0	470.7	544.9	584.0	524.0	463.5	508.8
Elevation Crest Emergency Spillway	Ft.	558.3	497.9	571.2	530.8	564.4	495.1	467.3	539.0	581.5	521.5	460.9	506.3
Elevation Crest High Stage Inlet	Ft.	553.1	488.2	561.5	525.4	556.3	483.1	459.5	531.6	574.9	514.9	453.2	498.7
Elevation Crest Low Stage Inlet	Ft.	551.9	481.7	554.7	520.4	550.1	480.0	454.6	524.0	568.6	509.8	447.9	491.8
Maximum Height of Dam	Ft.	92	44	36	32	31	67	29	36	29	25	27	31
Volume of Fill	Cu.Yds.	1,005.3	73.0	35.8	19.7	21.2	316.6	35.8	27.4	30.2	14.8	32.4	20.7
Total Capacity	Ac.Ft.	24,796	291	207	84	83	5,022	306	169	89	63	76	104
Sediment Submerged 100 years	Ac.Ft.	349	72	13	24	20	209	55	38	18	14	18	22
Sediment Aerated	Ac.Ft.	44	9	5	3	2	26	7	5	2	2	2	3
Recreation	Ac.Ft.	19,899	-	-	-	-	1,964	-	-	-	-	-	-
Municipal & Industrial	Ac.Ft.	100	-	-	-	-	-	-	-	-	-	-	-
Retarding	Ac.Ft.	4,404	210	159	58	61	2,823	244	127	69	47	55	78
Between High & Low Stage	Ac.Ft.	775	58	44	19	20	476	61	38	22	16	19	25
Surface Area													
Sediment Pool	Acres	56	8	6	3	3	36	11	5	3	3	3	3
Recreation Pool	Acres	652	-	-	-	-	152	-	-	-	-	-	-
Municipal & Industrial	Acres	654	-	-	-	-	-	-	-	-	-	-	-
Retarding Pool	Acres	740	19	15	9	6	226	30	16	9	5	6	10
Principal Spillway													
Runoff Volume (1 day) 1/	In.	4.80	4.30	3.85	3.85	3.85	4.8	3.85	4.30	3.85	3.85	3.85	3.85
Runoff Volume (10 day) 1/	In. R	9.60	8.60	7.70	7.70	7.70	9.6	7.70	8.60	7.70	7.70	7.70	7.70
Capacity of Low Stage (Max.)	c.f.s.	55	4.4	3.3	1.4	1.5	35	4.6	2.9	1.6	1.2	1.4	1.8
Capacity of High Stage (Max.)	c.f.s	481	77	38	34	33	200	33	70	34	30	32	34
Frequency Operation- Emerg. Spillway	% chance	1	2	4	4	4	1	4	2	4	4	4	4
Size of Conduit	Dim.	48	24	18	18	18	36	18	24	18	18	18	18
Emergency Spillway													
Rainfall Volume (FSH) (areal)	In.	10.17	7.20	4.60	4.60	4.60	10.40	4.60	7.20	4.60	4.60	4.60	4.60
Runoff Volume (ESH)	In.	7.68	4.88	2.55	2.55	2.55	7.90	2.55	4.88	2.55	2.55	2.55	2.55
Type		Rock	Rock	Veg.	Veg.	Veg.	Rock	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Ft.	350	20	20	20	20	100	20	20	20	20	20	20
Velocity of Flow (Ve)	Ft./Sec.	6.7	8.4	0	0	0	9.7	0	7.2	0	0	0	0
Slope of Exit Channel	Ft./Ft.	.03	.028	.035	.035	.035	.024	.035	.03	.035	.04	.035	.035
Maximum Water Surface Elevation	Ft.	560.4	500.6	570.2	530.7	564.4	499.0	465.8	541.3	581.4	521.5	460.9	506.2
Freeboard													
Rainfall Volume (FH) (areal)	In.	26.20	13.70	8.45	13.70	8.04	26.80	8.83	13.6	8.04	8.04	8.04	8.05
Runoff Volume (FH)	In.	23.43	11.10	6.05	11.10	5.66	24.02	6.41	11.0	5.66	5.66	5.66	5.67
Maximum Water Surface Elevation	Ft.	566.6	505.1	574.6	535.9	567.2	509.0	470.7	544.9	584.0	524.0	463.5	508.8
Capacity Equivalents													
Sediment Volume	In.	0.5	1.4	1.1	1.4	1.1	0.5	1.0	1.1	0.9	1.1	1.0	1.0
Retarding Volume	In.	6.0	3.6	3.6	3.0	3.0	5.9	4.0	3.3	3.1	2.9	3.0	3.1

1/ Method 2, Chapter 21, Section 4 Hydrology Guide, (Rev. January 1971)

2/ Exceeds SCS Engineering Memorandum 27 minimum to comply with IDNR criteria

3/ Class "a" structure with "b" freeboard hydrology for added road protection

Sheet 1 of 4

July 1975

TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Anderson River Watershed, Indiana

ITEM	UNIT	Structures												
		U-29	U-30	U-31	U-34	U-35	U-36	U-37	U-38	I-5	I-6	I-7	I-13	I-17
Class of Structure		a	a	a	a	a	a	a	a	a	a	a	b	a
Drainage Area	Sq.Mi.	0.77	0.32	0.45	0.78	0.75	0.85	1.44	1.29	0.34	0.40	0.61	0.30	0.39
Curve No. (1-day)(AMC II)	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Tc	Hrs.	0.5	0.4	0.4	0.5	0.5	0.5	0.6	0.9	0.4	0.3	0.4	0.4	0.3
Elevation Top of Dam	Ft.	481.2	464.7	472.1	542.1	568.1	530.1	555.4	528.9	535.6	536.8	520.9	507.0	472.4
Elevation Crest Emergency Spillway	Ft.	478.2	462.3	469.5	539.2	564.9	526.9	547.8	524.8	533.0	534.4	518.1	502.0	470.1
Elevation Crest High Stage Inlet	Ft.	470.4	455.3	463.1	531.9	556.0	519.5	537.4	512.8	525.9	528.0	511.2	496.3	464.8
Elevation Crest Low Stage Inlet	Ft.	464.9	450.0	456.7	525.7	548.8	513.6	531.4	504.8	518.4	522.1	505.7	490.4	460.2
Maximum Height of Dam	Ft.	31	25	33	35	39	42	38	43	32	32	34	32	23
Volume of Fill	Cu.Yds.	28.0	21.2	29.6	37.8	41.0	51.3	61.7	66.0	30.7	27.4	38.1	24.9	21.6
Total Capacity	Ac.Ft.	190	65	105	186	181	216	416	348	68	86	151	59	91
Sediment Submerged 100 years	Ac.Ft.	37	12	28	33	39	49	75	61	15	19	38	14	21
Sediment Aerated	Ac.Ft.	5	2	3	4	5	5	9	8	2	2	5	2	4
Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-	-	-	-	-
Municipal & Industrial	Ac.Ft.	-	-	-	-	-	-	-	-	-	-	-	-	-
Retarding	Ac.Ft.	149	51	74	148	137	161	331	279	52	64	109	43	66
Between High and Low Stage	Ac.Ft.	41	17	24	42	40	45	77	69	18	21	33	18	21
Surface Area														
Sediment Pool	Acres	6	3	3	5	5	7	11	7	2	3	5	2	4
Recreation Pool	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-
Municipal & Industrial	Acres	-	-	-	-	-	-	-	-	-	-	-	-	-
Retarding Pool	Acres	17	6	10	19	15	21	33	24	6	9	14	6	10
Principal Spillway														
Runoff Volume (1 day) 1/	In.	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	4.30	3.85
Runoff Volume (10 day) 1/	In.	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	8.60	7.70
Capacity of Low Stage (Max.)	c.f.s.	3.1	1.3	1.8	3.1	3.0	3.4	5.7	5.1	1.4	1.6	2.5	1.0	1.6
Capacity of High Stage (Max.)	c.f.s.	36	29	36	38	41	42	37	40	35	36	38	66	29
Frequency Operation-Emer. Spillway	% chance	4	4	4	4	4	4	4	4	4	4	4	2	4
Size of Conduit	Dim.	18	18	18	18	18	18	18	18	18	18	18	24	18
Emergency Spillway														
Rainfall Volume ESH(Areal)	In.	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	7.20	4.60
Runoff Volume (ESH)	In.	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	4.88	2.55
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Ft.	20	20	20	20	20	20	20	20	20	20	20	20	20
Velocity of Flow (Ve)	Ft./Sec.	0	0	0	0	0	0	0	0	2.1	0	0	6.2	0
Slope of Exit Channel	Ft./Ft.	.035	.035	.035	.035	.035	.035	.035	.035	.035	.035	.035	.032	.035
Maximum Water Surface Elevation	Ft.	477.3	462.2	469.4	538.4	564.3	526.2	545.5	522.7	533.1	534.3	517.7	503.7	469.9
Freeboard														
Rainfall Volume (FH)(Areal)	In.	8.38	8.04	8.06	8.37	8.35	8.48	13.60	8.99	8.04	8.04	8.24	13.6	7.30
Runoff Volume (FH)	In.	5.99	5.66	5.68	5.97	5.95	6.08	11.00	6.56	5.66	5.66	5.85	11.0	4.97
Maximum Water Surface Elevation	Ft.	481.2	464.7	472.1	542.1	568.1	530.1	555.4	528.9	535.6	536.8	520.9	507.0	472.4
Capacity Equivalents														
Sediment Volume	In.	1.0	0.8	1.3	0.9	1.1	1.2	1.1	1.0	0.9	1.0	1.3	1.0	1.2
Retarding Volume	In.	3.6	3.0	3.1	3.6	3.4	3.5	4.3	4.1	2.9	3.0	3.3	2.7	3.2

1/ Method 2, Chapter 21, Section 4 Hydrology Guide, (Rev. January 1971)
2/ Exceeds SCS Engineering Memorandum 27 minimum to comply with IDNR criteria
3/ Class "a" structure with "b" freeboard hydrology for added road protection

Sheet 2 of 4
July 1975

TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Anderson River Watershed, Indiana

UNIT	Structures										
	L-18	L-21	L-24	L-26	L-29	L-30	L-32	L-35	L-36	L-37	L-38
Class of Structure	a	a	b	a	a	a	b	a	a	a	a
Drainage Area											
Curve No. (1-day)(AWC II)											
Tc											
Elevation Top of Dam	80	80	80	80	80	80	80	80	80	80	80
Elevation Crest Emergency Spillway	436.4	495.5	488.6	451.7	495.5	1.02	0.4	0.5	0.4	0.5	0.5
Elevation Crest High Stage Inlet	43.9	491.8	482.8	449.3	492.8	429.3	494.0	499.7	451.7	470.7	457.4
Elevation Crest Low Stage Inlet	457.0	482.7	476.5	444.9	485.7	419.1	487.4	494.0	446.8	462.3	452.8
Maximum Height of Dam	451.3	477.8	473.6	441.7	479.8	413.4	481.5	490.0	442.6	456.5	449.7
Volume of Fill	28	29	35	18	29	41	36	26	25	27	20
Total Capacity	27.0	47.7	50.6	15.7	23.6	77.4	50.2	39.0	24.6	28.3	10.4
Sediment Submerged 100 years	80	375	408	66	110	852	96	191	82	251	65
Sediment Acreated	21	63	56	17	25	141	23	47	18	37	21
Recreation	3	7	7	2	5	17	4	6	2	5	3
Municipal & Industrial	-	-	-	-	-	-	-	-	-	-	-
Retarding	-	-	120	-	-	-	-	-	-	-	-
Between High and Low Stage	57	305	225	46	80	694	69	138	62	209	41
Surface Area	19	70	57	15	25	158	23	37	20	52	14
Sediment Pool	3	12	12	5	4	23	4	8	4	8	5
Recreation Pool	-	-	-	-	-	-	-	-	-	-	-
Municipal & Industrial	-	-	21	-	-	-	-	-	-	-	-
Retarding Pool	7	33	31	8	9	67	8	22	11	24	6
Principal Spillway											
Runoff Volume (1 day) 1/	3.85	3.85	4.30	3.85	3.85	3.85	4.30	3.85	3.85	3.85	3.85
Runoff Volume (10 day) 1/	7.70	7.70	8.60	7.70	7.70	7.70	8.60	7.70	7.70	7.70	7.70
Capacity of Low Stage (Max.)	1.4	5.3	4.2	1.1	1.9	11.8	1.8	2.8	1.5	3.9	1.0
Capacity of High Stage (Max.)	33	33	68	25	34	69	69	32	31	32	27
Frequency Operation-Emer. Spillway	4	4	2	4	4	4	2	4	4	4	4
Size of Conduit	18	18	24	18	18	24	24	18	18	18	18
Emergency Spillway											
Rainfall Volume (ESH)(Areal)	4.60	4.60	7.20	4.60	4.60	4.60	7.20	4.60	4.60	4.60	4.60
Runoff Volume (ESH)	2/55	2.55	4.97	2.55	2.55	2.55	4.88	2.55	2.55	2.55	2.55
Type	Veg.	Veg.	Veg.	Veg.	Veg.	Rock	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	20	20	20	20	20	40	20	20	20	20	20
Velocity of Flow (Ve)	0	0	6.9	0	0	0	6.9	0	0	0	0
Slope of Exit Channel	0.35	0.35	0.30	0.35	0.35	0.35	0.31	0.35	0.35	0.35	0.35
Maximum Water Surface Elevation	463.9	489.7	481.9	449.3	492.5	426.8	496.0	499.0	451.5	469.3	457.3
Freeboard											
Rainfall Volume (FH)(Areal)	8.04	9.09	13.7	7.30	8.08	10.92	13.60	8.39	7.30	8.62	7.30
Runoff Volume (FH)	5.66	6.66	11.1	4.97	5.70	8.40	11.00	5.99	4.97	6.21	4.97
Maximum Water Surface Elevation	466.4	495.5	488.6	451.7	495.5	435.0	499.8	502.3	454.1	473.8	459.8
Capacity Equivalents											
Sediment Volume	1.2	1.0	1.1	1.3	1.2	1.0	1.2	1.4	1.0	0.8	1.7
Retarding Volume	3.0	4.4	3.9	3.1	3.2	4.4	2.9	3.7	3.1	4.0	3.0

1/ Method 2, Chapter 21, Section 4 Hydrology Guide, (Rev. January 1971)

2/ Exceeds SCS Engineering Memorandum 27 minimum to comply with IDNR criteria

3/ Class "a" structure with "b" freeboard hydrology for added road protection

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TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Anderson River Watershed, Indiana

ITEM	UNIT	Structures										Total
		I-45	I-46	I-48	I-50	I-51	I-52	I-53	I-54	I-55	I-56	I-59
Class of Structure		a	a	a	b	b	a	a	a	a	a	a
Drainage Area	Sq. Mi.	0.32	0.96	0.73	0.31	0.41	0.76	0.40	0.72	1.68	0.34	0.36
Curve No. (1-day)(ANC II)		80	80	80	80	80	80	80	80	80	80	80
Tc	Hrs.	0.3	0.6	0.5	0.5	0.4	0.5	0.4	0.5	1.2	0.3	0.4
Elevation Top of Dam	Ft.	466.4	490.7	447.7	455.3	475.8	459.0	467.8	481.6	562.9	460.8	448.2
Elevation Crest Emergency Spillway	Ft.	464.0	487.5	445.0	450.8	470.7	456.3	465.6	478.9	557.8	458.4	445.8
Elevation Crest High Stage Inlet	Ft.	458.3	480.2	439.0	446.1	465.0	450.0	459.7	472.6	547.9	453.3	440.9
Elevation Crest Low Stage Inlet	Ft.	453.7	475.6	435.6	442.0	459.6	446.2	453.9	467.7	540.9	449.0	436.8
Maximum Height of Dam	Ft.	23	32	21	22	29	25	24	28	44	22	25
Volume of Fill	Cu.Yds.	15.3	39.7	27.2	17.2	20.6	29.4	16.4	25.5	69.7	12.5	17.4
Total Capacity	Ac.Ft.	74	276	189	61	88	199	84	182	423	75	95
Sediment Submerged 100 Years	Ac.Ft.	21	69	31	10	20	41	15	38	90	16	31
Sediment Aerated	Ac.Ft.	3	8	4	2	2	4	2	4	11	2	4
Recreation	Ac.Ft.	-	-	-	-	-	-	-	-	-	-	-
Municipal & Industrial	Ac.Ft.	-	-	-	-	-	-	-	-	-	-	-
Retarding	Ac.Ft.	50	199	154	50	66	154	67	140	322	57	60
Between High and Low Stage	Ac.Ft.	17	51	39	18	22	41	21	38	90	18	19
Surface Area												
Sediment Pool	Acres	4	11	10	3	3	9	3	7	11	4	5
Recreation Pool	Acres	-	-	-	-	-	-	-	-	-	-	-
Municipal & Industrial	Acres	-	-	-	-	-	-	-	-	-	-	-
Retarding Pool	Acres	7	25	22	8	10	22	11	21	29	9	10
Principal Spillway												
Runoff Volume (1 day) 1/	In.	3.85	3.85	3.85	4.30	4.30	3.85	3.85	3.85	3.85	3.85	3.85
Runoff Volume (10 day) 1/	In.	7.70	7.70	7.70	8.60	8.60	7.70	7.70	7.70	7.70	7.70	7.70
Capacity of Low Stage (Max.)	c.f.s.	1.3	3.8	3.0	1.2	1.6	3.1	1.6	2.9	6.7	1.4	1.5
Capacity of High Stage (Max.)	c.f.s.	32	36	27	48	61	31	30	33	82	28	31
Frequency Operation-Emer. Spillway % chance		4	4	4	2	2	4	4	4	4	4	4
Size of Conduit	Dim.	18	18	18	24	24	18	18	18	24	18	18
Emergency Spillway												
Rainfall Volume (ESH)(Areal)	In.	4.60	4.60	4.60	7.20	7.20	4.60	4.60	4.60	4.60	4.60	4.60
Runoff Volume (ESH)	In.	2.55	2.55	2.55	4.88	4.88	2.55	2.55	2.55	2.55	2.55	2.55
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Ft.	20	20	20	20	20	20	20	20	20	20	20
Velocity of Flow (Ve)	Ft./Sec.	0	0	0	5.8	6.1	0	0	0	0	0	0
Slope of Exit Channel	Ft./Ft.	.035	.035	.035	.034	.033	.035	.035	.035	.035	.035	.035
Maximum Water Surface Elevation	Ft.	464.0	486.3	443.9	452.3	472.5	455.4	465.5	478.2	556.5	458.3	445.6
Freeboard												
Rainfall Volume (FH)(Areal)	In.	7.30	8.71	2/ 8.38	2/ 13.70	13.70	8.42	2/ 8.04	2/ 8.36	2/ 9.28	2/ 8.04	7.30
Runoff Volume (FH)	In.	4.97	6.30	5.98	11.10	11.10	6.02	5.66	5.96	6.83	5.66	4.97
Maximum Water Surface Elevation	Ft.	466.4	490.7	447.7	455.3	475.8	459.0	467.8	481.6	562.9	460.8	448.2
Capacity Equivalents												
Sediment Volume	In.	1.4	1.5	0.9	0.7	1.0	1.1	0.8	1.1	1.1	1.0	1.8
Retarding Volume	In.	2.9	3.9	4.0	3.0	3.0	3.8	3.1	3.7	3.6	3.1	3.1

1/ Method 2, Chapter 21, Section 4 Hydrology Guide, (Rev. January 1971)

2/ Exceeds SCS Engineering Memorandum 27 minimum to comply with IDNR criteria

3/ Class "a" structure with "b" freeboard hydrology for added road protection

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TABLE 3A - STRUCTURE DATA

CHANNELS

Anderson River Watershed, Indiana

Channel Cross Section	Channel Station 2/	Drainage Area (sq.mi.)	Design Flow (cfs)1/	Flow Depth (ft.)1/	Bottom Width (ft.)	'n' value		Design Velocity (ft/sec)1/	Type of Work 3/	Before Project	
						Existing	Designed (aged)			Channel Type 4/	Project Flow Condition 5/
ID-22	1185+00 to 1335+00	85.82	620	12.9	19	0.060	0.052	1.6	IV	N	Pr
ID-20	1335+00 to 1481+00	96.68	450	10.3	13	0.055	0.050	1.8	IV	N	Pr
ID-17	1481+00 to 1554+00	107.08	640	9.9	27	0.055	0.050	1.7	IV	N	Pr
ID-15	1554+00 to 1680+00	111.37	890	12.1	22	0.055	0.050	1.9	IV	N	Pr
ID-14	1680+00 to 1756+00	116.57	1030	12.7	19	0.060	0.052	1.8	IV	N	Pr

1/ These values are at bank full depth.

2/ Channel work begins at Sta. 1185+00 (Hurricane Creek outlet) and ends at Sta. 1756+00 (Huffman covered bridge).

3/ IV - Clearing and removal of loose debris within channel section.

4/ N - An unmodified, well defined natural channel or stream.

5/ Pr - Perennial flow at all times except during extreme drought.

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TABLE 4 - ANNUAL COST

Anderson River Watershed, Indiana

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
All Structural Measures	342,512	80,757	423,269
Project Administration	61,540	: : : : : : : : : : : : : : : :	61,540
GRAND TOTAL	404,052	80,757 <u>3/</u>	484,809

1/ Price base: Installation and O&M: 1973

2/ 100 years @ $5\frac{7}{8}$ percent interest.

3/ Includes \$72,392 for operation, maintenance, and replacement for the recreational facilities.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Anderson River Watershed, Indiana

(Dollars) 1/

Item	Estimated Average Annual Damage Without Project	Estimated Average Annual Damage With Project	Damage Reduction Benefit
Floodwater			
Crop and Pasture	230,544	123,877	106,667
Other Agricultural	51,957	24,390	27,567
Nonagricultural			
Road and Bridge	10,905	3,914	6,991
Subtotal	293,406	152,181	141,225
Erosion			
Floodplain Scour	5,241	2,496	2,745
Indirect	31,504	16,057	15,447
TOTAL	330,151	170,734	159,417

1/ Price Base: Current normalized prices, as approved by the Water Resources Council - February 1974, for agricultural items and 1973 prices for other items.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Anderson River Watershed, Indiana

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/						3/ Avg. Annual Cost	Benefit Cost Ratio
	2/ Damage Reduction	Changed Land Use	More Intensive Use	Recrea- tion	M&I Water Supply	Secon- dary	Total Benefit	
ALL STRUCTURAL MEASURES	154,625	8,580	14,030	394,031	6,632	126,993	704,891	1.7:1.0
Project	: : : :	: : : :	: : : :	: : : :	: : : :	: : : :	: : : :	: : : :
Administration	: : : :	: : : :	: : : :	: : : :	: : : :	: : : :	: : : :	: : : :
GRAND TOTAL	154,625	8,580	14,030	394,031	6,632	126,993	704,891	1.5:1.0

1/ Price Base: Current normalized prices, as approved by Water Resources Council - February 1974, for agricultural items and 1973 prices for other items.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$4,792 annually.

3/ From Table 4

INVESTIGATIONS AND ANALYSES

Land Treatment

Basic data for watershed land use and treatment under the "going" and "accelerated" programs were prepared by the sponsoring Soil and Water Conservation Districts with assistance from local Service employees and personnel of the U. S. Forest Service. Procedure used in developing the data began with a listing of predominant watershed soils by capability class, sub-class and unit. Soils having similar use capabilities, treatment needs, and hydrologic characteristics were combined into soils groups.

Present and anticipated future "with project" use and treatment of soils within each grouping were then determined. Resources employed in this determination included Conservation Needs Inventories, Land Resource Area Maps, soil surveys, basic conservation plans and the considerable knowledge of local leaders familiar with the watershed.

The resultant land use and treatment data provided the basis for estimation of future "with" and "without project" runoff and erosion in the watershed. Specific studies as to the hydrologic condition of watershed forest land areas were undertaken by U. S. Forest Service personnel and supplemented the above data. Such studies involved observation and measurement of hydrologic and/or related factors on a series of systematically selected field plots.

A measure of the scope of the presently applied land treatment program within the watershed as well as the accelerated program to be applied is presented in Table 1A and the land treatment portion of Table 1 respectively.

Hydraulics

Sixty-six valley cross-sections were located on U.S.G.S. topographic maps at points which would best reflect hydraulic behavior and present typical acres inundated. The roads and bridges were carefully studied in the field and it was decided that 20 bridges warranted further study. The 66 valley cross sections and 20 bridge sections with road profiles were surveyed to mean sea level datum and used in this analysis.

In the vicinity of each cross-section the channel and overbank were observed and channel and valley "n" values were estimated. The procedures described in the "National Engineering Handbook, Section 5, Hydraulics, Supplement B" and Geological Water Supply Paper 1849, "Roughness Characteristics of Natural Channels" were used for the estimates. Assigned "n" values were intended to reflect an average for the stream reach represented by the valley cross section in question. The bridges were studied to determine the specific design characteristics of each bridge to meet the input requirements of the hydraulics computer program. Reach lengths and drainage areas were based on measurements from U.S.G.S. topographic maps.

An electronic computer using the SCS water surface profile program was used to study the "without project" and "with project" hydraulic flow characteristics of the watershed. An average slope was computed for the first cross section at the Ohio River to start the water surface profiles. Thirteen

profiles were computed at carefully selected discharges (cfs) to rate the channel and valley at various flood depths for each project condition. Reductions in Manning's "n" value for project alternates involving log jam and channel debris removal were based on the procedure of segmenting the channel wetted perimeter and applying obstruction removal to the lower portion. Rating curves obtained from the water surface profile program were used in subsequent watershed flood routings.

Hydrology

The closest stream gage to the watershed was on the Middle Fork of Anderson River at Bristow. It was established August 1961 and was therefore considered to have too short a record for frequency analysis. Its record was compared, however, with records from stream gages in surrounding watersheds. From this analysis it was concluded that Anderson River Watershed acted very similar hydrologically to the Patoka River Watershed located to the north. Other gage data considered was Indian Creek and Blue River located to the east of Anderson River.

A tabulation of soils and land use was prepared by the District Conservationist in each county of the watershed. From this information the Soil Cover Complex number (CN) was determined. The applicable CN for the watershed, considering antecedent moisture condition II, was set at 80.

Rainfall for various storm frequencies was then obtained from the U. S. Department of Commerce Weather Bureau, Technical Paper No. 40, "Rainfall Frequency Atlas of the United States" and Technical Paper No. 57, "Normal Monthly Number of Days with Precipitation of 0.5, 1.0, 2.0, and 4.0 Inches or More in the Contiguous United States". Such rainfalls were converted to runoff using CN 80 and antecedent moisture condition II. Runoff volumes so converted were found to be less than recorded runoffs through the Patoka gage for storms of comparable frequency. Rainfall volumes used in the hydrologic analysis were therefore adjusted upward to produce runoff comparable to gage data.

Reach lengths and routing time interval were carefully selected so that the routing coefficient C and the modified coefficient C* would be comparable in numeric value. Time of concentration (Tc) was computed for each subwatershed using nomograph figure 3.15-3 "National Engineering Handbook, Section 4, Hydrology" for overland flow and using bank full velocities for channel and valley flows.

Middle Fork of Anderson River, a P.L. 566 project under construction, was treated as in place in the evaluation of Anderson River Watershed. The project engineer's structure designs and proposed channel designs were used in routing the Middle Fork portion of Anderson River for all alternates studied.

All hydrologic evaluation was performed on electronic computer using the SCS Computer Program for Project Formulation, Hydrology (TR-20). Evaluation flood routings were made, for the most part, using the standard 24 hour rainfall distribution SCS-272a and six selected flood frequencies. (See table of "Flood Routing Alternates" at the end of this section for exceptions.) Routed flood frequencies and their associated runoffs are as follows: the 100 year (5.4 inches), the 10 year (3.6 inches), the 5 year (3.1 inches), the 2 year (2.4 inches), the 1 year (1.9 inches) and the 0.33 year (0.6 inches).

-Analyses - Hydrology-

To compare the routed storms with historical data a profile was plotted of the high water elevations established by the Indiana Department of Natural Resources for the floods of January 1959 and March 1964. The 0.3, 2, 10, and 100 year frequency evaluation flood profiles were also plotted. The January 1959 profile plotted generally between the 10 and 100 year frequency evaluation flood. The March 1964 flood also plotted between the 10 and 100 year frequency evaluation flood with the exception of the lower portion of the watershed where historical elevations were higher than the 100 year evaluation flood. The Ohio River was high during this time and was believed a major factor in producing the higher elevations recorded.

The 100 year "without project" routed flood elevations were then located on U.S.G.S. topographic maps and the 100 year flood plain outlined. Outlined flood plain areas were measured in segments associated with various surveyed valley cross sections. Channel areas were excluded from measured flood plain segments. Resultant flood plain areas were then divided by corresponding flood areas computed from the water surface profile program. The resulting ratio provided the adjustment factor used in the Economics II computer program. A comprehensive list of structural measure alternates studied hydrologically during the plan formulation process is shown in the table of "Flood Routing Alternates". The period of study of project alternates covered parts of four years from 1969 to the present. Alternates 1 through 13 were analyzed during 1969 and 1970 in preparation of a draft work plan dated May 1970. Subsequent alternates were studied in pursuit of a modified work plan more compatible with current Service policy and environmental objectives. Alternates 50 and 53 reflect the "without project" and "with project" conditions used in preparing this plan. Pertinent hydrologic data for these two alternates is presented in the table of "Frequency-Discharge-Stage Relationships for Selected Locations".

FACT SHEET - DISCHARGE - STAGE RELATIONSHIPS FOR SELECTED LOCATIONS

Without Project and Project Installed
Anderson River Watershed, Indiana

-Analyses - Hydrology-

No.	Stn. No.	Damage Begins Elev.	100 Year Flood			10 Year Flood			1 Year Flood		
			Without Proj.		Proj.	Without Proj.		Proj.	Without Proj.		Proj.
			Disch.	Elev.	Disch.	Disch.	Elev.	Disch.	Disch.	Elev.	Disch.
			c.f.s.	ft.	c.f.s.	c.f.s.	ft.	c.f.s.	c.f.s.	ft.	c.f.s.
1	3	372.0	16203	387.9	15698	11338	384.8	11243	6822	379.7	6664
2	9	382.5	11822	396.2	7821	7352	392.9	5270	3695	389.1	2875
3	12	391.5	11859	400.4	7862	7375	397.5	5309	3710	394.3	2913
4	14	394.0	11915	401.8	7907	7299	399.4	5339	3716	397.0	2926
5	17	399.0	12101	408.5	7944	7470	406.3	5402	3742	403.7	2997
6	20	404.5	12075	411.0	7647	7441	409.2	5214	3727	407.4	2942
7	24	412.0	10346	418.3	4791	6470	417.0	3299	3259	415.5	1900
8	27	429.0	10953	433.7	4365	6972	432.3	3041	3562	430.6	1722
9	30	440.0	9107	445.7	3564	5909	444.4	2457	2961	442.7	1227
10	33	452.0	8198	459.2	2673	5374	457.4	1853	2705	455.1	881
11	35	482.3	7267	486.9	1196	4886	485.8	779	2520	484.4	394
12	39	386.0	1743	393.5	1587	1530	391.9	1248	1121	389.5	708
13	64	406.0	2228	409.7	1661	1592	408.5	1168	929	407.3	651
14	70	413.5	1909	418.0	1229	1290	416.8	818	661	415.5	425
15	81	435.5	1204	437.3	264	816	436.7	170	427	435.6	90
16	82	440.5	1790	443.8	1341	1217	443.0	901	644	441.8	471
17	83	441.1	3619	445.3	961	2393	444.3	626	1217	443.1	316
18	67	403.5	958	409.2	695	663	407.7	479	372	405.8	271
19	69	416.0	1919	420.5	722	1292	419.0	470	665	417.6	241
20	73	418.0	4948	422.0	2605	3327	420.8	1814	1784	419.7	901
21	74	410.5	4905	416.4	3552	3177	415.3	2384	1627	413.9	1212
22	75	419.0	4148	422.2	2887	2653	421.3	1886	1334	420.4	956
23	76	427.0	3414	430.4	2421	2195	429.7	1591	1102	428.7	775
24	78	416.5	3133	420.7	1898	2058	419.6	1239	1051	418.4	631
25	79	428.5	2054	430.8	1535	1373	430.2	1062	697	429.5	499
26	88	438.0	1211	440.0	381	810	439.5	250	425	438.9	129
27	80	434.5	2177	438.2	810	1463	437.4	554	750	436.3	278
28	77	447.5	3568	451.2	2486	2320	450.5	1622	1156	449.4	763
29	85	492.0	1162	494.5	219	785	493.7	116	407	492.5	56
30	86	504.5	3229	506.8	569	2175	506.2	346	1121	505.4	174
40	58	381.0	*	393.4	*	*	390.0	*	*	386.1	*
41	60	388.0	*	396.9	*	*	393.4	*	*	389.9	*
62	62	393.5	*	401.5	*	*	399.0	*	*	396.5	*

FLOOD ROUTING ALTERNATES

Alternate Number	Structural Measures in Place	Area Analyzed
1	Without Project	Entire Watershed
2	3-M.P. structures, 20-S.P. structures	Entire Watershed
3	3-M.P. structures, 19-S.P. structures	Entire Watershed
4	3-M.P. structures, 15-S.P. structures	Entire Watershed
5	3-M.P. structures, 16-S.P. structures	Entire Watershed
6	Structure 30 (Brushy Fork), structure 26 (Blackhawk Creek)	Sub-Watersheds
8	3-M.P. structures, 15-S.P. structures, 25.6 miles S.W. (26 B. W. or less excavated from one side)	Entire Watershed
9	3-M.P. structures, 15-S.P. structures, 25.6 miles C.W. (32 feet B. W. or less excavated from one side)	Entire Watershed
10	3-M.P. structures, 15-S.P. structures, 25.6 miles C.W. (40 feet B.W. or less excavated from one side)	Entire Watershed
11	3-M.P. structures, 15-S.P. structures, 14.8 miles C.W. (26 feet B.W. or less excavated from one side)	Entire Watershed
12	3-M.P. structures, 15-S.P. structures, 14.8 miles C.W. (32 feet B.W. or less excavated from one side)	Entire Watershed
13	3-M.P. structures, 15-S.P. structures, 14.8 miles C.W. (26 feet B.W. or less excavated from one side)	Entire Watershed
14	3-M.P. structures, 15-S.P. structures (Modified Rainfall Distribution)	Entire Watershed

FLOOD ROUTING ALTERNATES

Alternate Number	Structural Measures in Place	Area Analyzed
15	3-M.P. structures, 15-S.P. structures (Standard Rainfall Distribution, SCS-272a, and modified rainfall)	Entire Watershed
16	3-M.P. structures, 15-S.P. structures	Entire Watershed
17	3-M.P. structures, 15-S.P. structures (modified rainfall distribution and two-stage structure design)	Entire Watershed
18	3-M.P. structures, 10-S.P. structures	Entire Watershed
19	3-thout Project (project runoff from high rain low CN)	Lanman Run
20	Without Project (project runoff from project rains)	Lanman Run
21	Without Project (using TP-40 rain, CN=80)	Entire Watershed
22	3-M.P. structures, 14-S.P. structures	Entire Watershed
23	3-M.P. structures, 15-S.P. two-stage structures	Entire Watershed
24	48-S.P. structures	Blackhawk Creek Hurricane Creek
25	34-S.P. structures	Blackhawk Creek Hurricane Creek
30	3-M.P. structures, 2-S.P. structures	Entire Watershed
31	3-M.P. structures, 3-S.P. structures	Entire Watershed
32	3-M.P. Structures, 5-S.P. structures	Entire Watershed
33	3-M.P. structures, 8-S.P. structures	Entire Watershed

FLOOD ROUTING ALTERNATES

Alternate Number	Structural Measures in Place	Area Analyzed
34	3-M.P. structures, 11-S.P. structures	Entire Watershed
35	3-M.P. structures, 72-S.P. structures	Entire Watershed
36	3-M.P. structures, 56-S.P. structures	Entire Watershed
37	17-S.P. structures (1.5 inches low stage storage with 5 c.s.m. release)	Hurricane Creek
38	17-S.P. structures (2.0 inches low stage storage with 5 c.s.m. release)	Hurricane Creek
39	17-S.P. structures (2.5 inches low stage storage with 5 c.s.m. release)	Hurricane Creek
40	17-S.P. structures (with hooded inlet and no low stage storage)	Hurricane Creek
41	17-S.P. structures (0.5 inches low stage storage with 5 c.s.m. release)	Hurricane Creek
42	17-S.P. structures (1.0 inches low stage storage with 5 c.s.m. release)	Hurricane Creek
43	17-S.P. structures (1.0 inches low stage storage with 4 c.s.m. release)	Hurricane Creek
50	Without Project (watershed sub-divided as with project)	Entire Watershed
51	3-M.P. structures, 46-S.P. structures	Entire Watershed
52	3-M.P. structures, 46-S.P. structures with 10.5 miles of channel debris removal	Entire Watershed
53	3-M.P. Structures, 46-S.P. structures with 10.5 miles of log-jam removal	Entire Watershed

Economics

Identification of watershed problems and needs and consideration of effects of proposed improvements provided the basis for evaluation of project benefits. Such benefits were estimated through a comparison of future without project conditions to future conditions with project. Floodwater damages were evaluated using a projection of conditions expected to exist approximately 20 years after project installation.

Details of evaluation procedures used are described in the Economic Guide for Watershed Protection and Flood Prevention dated March, 1964. Current normalized prices as approved by the Water Resources Council, February 1974, were used in assigning monetary values to agricultural items. Other items and the operation and maintenance costs were estimated on the basis of 1973 costs. The cost of land treatment measures, technical assistance, and structural works of improvement were estimated at 1971 price levels. Installation costs for structural works of improvement were amortized at 5 7/8 percent for 100 years. Associated development costs necessary for the realization of full project benefits were amortized at 7 percent for 100 years or the expected life of the developments whichever was less. Estimates of land acquisition costs for project structural measures were subjected to an "other economic cost" analysis. Such analysis was made through a comparison of estimated income losses to the land as opposed to the annual equivalent of estimated land acquisition cost.

Multiple purpose structure joint costs were allocated through the "use of facilities" method. Sediment storage volume was assigned to the flood prevention purpose.

Floodwater Damage

The principal method used in evaluation of floodwater damages was the frequency method. This method involves the establishment of relationships between physical and economic flood characteristics and the probable frequency of flood occurrence. Routine computations required by the frequency method were made using the Economics II computer program, except in isolated instances where manual calculations were more expedient. Benefits to land treatment were estimated and subtracted from total project benefits to determine those attributable to structural measures.

Data for evaluating project agricultural effects and benefits was obtained from interview with local farmers, Soil Conservation Service employees and watershed residents. Information from soil surveys, observation on other projects, and publications pertaining to crop yields, acreages, costs and prices of agricultural supplemented interview data.

Damages to crops and pasture, other agricultural values, and road and bridges were adjusted to eliminate double counting arising through recurrent flooding in a given year. Problem areas not affected by the proposed project measures were not evaluated except when believed significant to project formulation. In recognition of backwater flooding from the Ohio River remaining crop and pasture damages with project were adjusted downward using

-Analyses - Economics-

the sum of 25 percent of the damages without project and 75 percent of the damages with project for Reaches 2, 4, and 11; 12 percent and 88 percent respectively for Reach 2A and 50 percent and 50 percent respectively for Reach 1. Backwater flooding in other reaches was not considered significant enough to warrant damage adjustment. The above percentages were estimated on the basis of flood elevations by frequency for Anderson River headwater and Ohio River backwater and from interview of farmers in the area.

Four depth increments of flooding were selected for elevation of crop and pasture flood damages. Those selected were 0-1 feet, 1-3 feet, 3-5 feet and over 5 feet. Crop and pasture flood depth-damage factors were then developed for each depth increment and for each month in which crop or pasture flood damage might be incurred. Basic considerations used in calculating these factors were yields after flooding, added and saved production expenses, and the net value of an alternate crop when applicable. Land use patterns used in the project evaluation were determined through field observation, landowner questionnaires, and through the study of aerial photos and topographic maps. Estimates of normal flood-free yields for future without project conditions were based on factors such as yields now attained by the better farmers, past trends and technological advances.

Flood damages to other agricultural values were evaluated utilizing depth-damage factors. Such factors were developed using interview data on each evaluation unit, analysis of total flood plain area and study of flood depths at various surveyed cross-sections. Damage factors for each depth increment were estimated by an arraying of the depth required before each type of damage began.

Interview data obtained from officials responsible for road and bridge maintenance in the watershed provided the basis for evaluation of road and bridge flood damages. This data together with an analysis of factors such as flood plain area in each evaluation unit, depth of flooding by surveyed cross-section, type of road, height of fill and length of road subject to flooding enabled depth-damage factors to be established.

The estimated monetary value of presentable physical land damage resulting from flood plain scour was based on the net value of lost production. This was considered as the damage without project. The reduction of damage caused by flood plain scour was determined using the same percent reduction as was obtained for crop and pasture.

Indirect damages were estimated at 10 percent of the agricultural damages and 25 percent of road and bridge damages.

Agricultural Enhancement Benefits

Enhancement type benefits were evaluated for changed land use and more intensive use of without project cropland. Such benefits reflect the estimated change in "net return" (gross benefit for each increment of enhancement less development costs, damage to higher values, and discounts for lag in accrual).

Yield increases used for the evaluation of the gross benefit to agricultural land enhancement were approximately 15 percent for corn and soybeans, 20 percent for wheat and oats, and 12 percent for hay. Areas evaluated were limited to those portions of the flood plain where substantial without project damages occur, and where expected damage reductions with project equaled or exceeded 50 percent for changed land use and 40 percent for more intensive use. Areas subject to flooding more often than once per year were excluded from the more intensive use evaluation and areas flooding more frequent than once each one and one-half years were excluded from the changed land use evaluation.

Estimated acres in flood plain areas affected by the project are shown in the following table for future conditions without project, after changed land use, and after more intensive use.

<u>Use</u>	<u>Without Project</u>	<u>With Changed Land Use</u>	<u>With More Intensive Use</u>
Corn	3,960	4,095	4,095
Soybeans	1,414	1,462	1,462
Wheat	358	373	373
Oats	71	73	73
Hay	569	589	589
Pasture	351	276	276
Woods	1,036	891	891
Other	305	305	305
TOTAL	8,064	8,064	8,064

Recreation Benefits

Estimates of recreation visitation on structure No. U-10 and its associated recreational development were supplied by private consultants employed by the Perry County Park and Recreation Board. Visitation on structure No. U-1 and its associated recreational development was provided by the U.S. Forest Service. All visitation estimates were reviewed relative to anticipated recreation demand, design capacity of the planned recreational developments, expected utilization of the developments on week days and week-end days during the fourteen week summer recreation season, and off-season usage. Such review substantiated the reasonableness of the visitation estimates and provided the basis for Service concurrence. Monetary benefits were estimated at \$2.25 per recreation visit based on the extensiveness and quality of the planned facilities.

Municipal and Industrial Water Supply Benefits

Municipal water supply benefits for structure No. L-24 were determined by consulting engineers for the Saint Meinrad Archabbey. The basis of determination was the least costly alternative for obtaining an equivalent supply of water, both in quantity and quality. Industrial water supply benefits for structure No. U-1 were determined by consulting engineers and were estimated on the basis of the upper limit that the Town of Birdseye could reasonably afford to pay, no other source of water in the required quantity being available within their cost limit.

-Analyses - Geology-

Secondary Benefits

Local secondary benefits were evaluated by using an income multiplier based on the economic base concept. An eleven county planning and development region, as designated by the State of Indiana was used to develop the multiplier. The major portion of the watershed is located in this region.

The multiplier includes economic activity resulting from production, utilization and disposition of intermediate goods and services as well as consumer spending.

The State multiplier, projected to reflect the year 2000, was modified to reflect the multiplier applicable to the region. This modification was based on the industry mix of basic and derivative industry in the region as compared to the State. The income multiplier to the region is 2.32 as compared to 2.42 for the State.

The multiplier was applied to estimate net increase of additional income generated within the region and estimated imported income from outside the region resulting from project development. Regional costs were deducted and the multiplier applied to the remaining benefits. Induced secondary losses were deducted to arrive at the net secondary benefits.

Geology

Structures - Preliminary geologic investigations were made of all multiple purpose dam sites included in this plan and of a representative number of single purpose sites. Available geologic maps, soils maps and well logs were intensively studied to determine the geology of each site investigated. Field investigations included visual inspection of surface features, hand auger borings or power auger borings.

Determinations were made of depth to bedrock, foundation and abutment conditions, borrow quantity and quality, type of bedrock and obvious geologic hazards. All pertinent information was recorded on form SCS-375, "Preliminary Geologic Investigation of Dam Sites".

More detailed investigations on structures U-1 and U-10 were undertaken because of structure size, cost and hazard. A drilling program was conducted to determine depth and types of foundation materials; geologic conditions at proposed emergency spillway cuts; seepage potential of foundation bedrock; and location, areal extent and classification of available borrow materials. Samples of foundation soils and potential embankment materials were taken at site U-1 for soil mechanics analysis and subsequent design recommendations. Rock cores from site U-1 were studied, along with water pressure test data to determine the seepage potential of foundation bedrock.

The northern and northeastern portion of the watershed is underlain by formations of the Chester Series. This area is typified by relatively thin sandy and silty clay overburden and underlying bedrock of shale with minor interbedded layers of sandstone and limestone. The central and northwestern portion of the watershed is underlain by the Mansfield Formation. This area

possesses similar overburden to the above described area but with bedrock of sandstone, shale and minor coals. Four multiple purpose and two single purpose watershed dams have been successfully constructed in the nearby Middle Fork of Anderson River Watershed in these same geologic formations.

Foundation bedrock is generally weathered at the surface to a depth of 6 inches to 2 feet. Some minor limestone layers exhibit small discontinuous solution cavities which appear limited in areal extent primarily to outcrop areas. Foundations will possess the necessary strength to support the load of all structures planned.

Seepage through the abutments of planned structures can be eliminated by removing all overburden and weathered bedrock in the abutment cutoff trench and back filling with impervious material. Seepage should be minimal through the foundations of these structures with cutoff at or near bedrock. Foundation drains will, however, be necessary to intercept any seepage that might occur.

The fine grained silts and clays directly overlying the flood plain foundations at sites U-1 and U-10 should be entirely removed due to their high consolidation potential. This will involve the stripping of an average of 8 feet of material at site U-1 and 6 feet at site U-10.

Readily available borrow at the small structure sites consists of alluvial deposits of material ranging from SM to SC and at the larger sites CL, ML, and CL-ML materials. Alluvial soils are the most abundant and accessible soils for borrow. These materials have been used successfully in small, private structures within the watershed and in the core and shell of six large watershed structures in the adjoining Middle Fork project. Depth of valley alluvium was found to vary as a function of drainage area size, larger drainage areas generally possessing thicker deposits. This function was expressed graphically on full logarithmic graph paper and used to estimate borrow area yields on the small structure sites.

Excessive moisture was found to be a problem in flood plain borrow areas of structure U-1. This condition is due to the long average seep distances through flood plain alluvial materials to existing channel outlets. A tile drainage system installed at least one year prior to construction is needed in these areas to dewater the upper six feet of borrow.

Deposits of plastic clay colluvium are available in adequate quantities at sites U-1 and U-10 for construction of impervious cores in the embankments. These deposits are found on the gentle slopes of scoured terraces that border upstream flood plain areas.

The following recommendations are made in the order of priority for selection of borrow areas.

1. Borrow from permanent pool areas (flood plain and terrace deposits) not closer than 300 feet upstream of the toe of the dam at multiple purpose structure sites or 200 feet at the small single purpose sites.

-Analyses - Geology-

2. Borrow from flood pool areas leaving one and one-half feet of soil to facilitate revegetation, or borrow from cleared flood plain areas below the structure, not closer than 200 feet from the downstream toe of the dam, if more practical. Downstream borrow pits so created could be converted to small ponds by placing pipe drop structures across the channel.
3. Borrow from a cleared upland area.

Emergency spillways on the small structures will require from 0 to 30 percent rock excavation, most of which is weathered and rippable. Emergency spillways on large structures will require from 20 percent to 50 percent rock excavation, some of which will be unweathered and will require drilling and blasting. Overburden and weathered rock material removed during emergency spillway construction can be placed in the outer shell of the structures.

Several coal mines exist within the middle reaches of the watershed, but all are inactive at present. Coal maps published by the Indiana Geological Survey indicate that shaft mines, strip mines, or drift mines are located near the proposed structure sites. Field investigations, aided by a local resident familiar with mining activities in the area, revealed that the coal maps were accurate and that none of the sites would be adversely affected. Mineral rights were also indicated to be no problem at the proposed sites. Correspondance with the Coal Section of the Indiana Department of Natural Resources Geological Survey revealed that there is a possibility of mineable Saint Meinrad coal at sites L-37, L-38, L-39, and L-40.

There is one abandoned oil well in the sediment pool of structure U-1. There are two abandoned oil wells at structure U-10 (one in the sediment pool and one just below the dam). There is also an abandoned gas well in the sediment pool of structure U-10. There are three active oil wells near structure L-32 (one in the permanent pool, one in the flood pool, and one adjacent to the flood pool). At structure L-51, there is one active oil well in the permanent pool. These are the only active or abandoned wells that will be affected by the project. The abandoned wells are shallow, averaging 500 feet in depth, and are dry. To insure that dry wells are tightly sealed when they are abandoned, Indiana State Law requires that a surety bond be purchased by the owners or persons responsible for the operation of all oil and gas wells in the state. Prior to construction these wells will be appraised as to the necessity of plugging or replugging by officials from the Indiana Department of Natural Resources, Division of Oil and Gas. If surface inspection or well records indicate that the wells are not properly sealed and if a surety bond has been purchased for the well, then the State will take necessary actions to insure proper closure. If there is not a surety bond for them the proper closure will need to be considered during the lands rights negotiations. All plugging or replugging of abandoned wells will be under the supervision of the Division of Oil and Gas.

The active wells will be closed under the regulations and supervision of the Indiana Department of Natural Resources, Division of Oil and Gas.

Small overburden slide areas in the right abutment of site U-1 and upstream from L-24 and U-12 indicate potential for emergency spillway slope stability problems. Slope failures in emergency spillways have occurred at two sites in the Middle Fork of Anderson River project due to slippage of saturated overburden over bedrock once the toe of the slope had been removed. Potential slide areas can be stabilized by the installation of drains to intercept water within the saturated zone. Slope stability problems will be evaluated thoroughly during the design stage of the project.

Recommendations for further investigations during design are as follows:

1. That a detailed geologic investigation be made of sites U-1, U-10, L-24, L-30 in accordance with the criteria as outlined in Chapter 7, Section 8, of the National Engineering Handbook.
2. That a detailed geologic investigation be made of small structure sites U-12, U-19, U-28, U-30, U-34, L-13, L-39, L-45, and L-52. Geologic conditions at these sites are typical of conditions at surrounding small structure sites. Information gathered at these locations should be applicable elsewhere with only token investigations needed for correlation.
3. That small structure sites not subjected to detailed geologic investigations be investigated to delineate and sample borrow areas, to determine depth to bedrock at the centerline, and to assure that soils and geologic conditions correlate with detailed site studies.

Cost estimates for site investigations are included on form SCS-375.

Storage requirements for sediment were computed on structure Nos. U-1, U-4, U-10, L-24 and L-30 and on 15 small single purpose structures. Determinations made on the 15 small structures were used in estimating storage requirements for other such structures in this plan. Sheet erosion quantities were computed using the Universal Soil Loss Equation. Gully, stream bank and stream bed erosion and flood plain scour quantities were estimated in the field.

The Universal Soil Loss Equation was applied using a statistical approach. Data on slope, slope length and land cover was determined for each structure drainage area studied using a systematic stratified random point count. This was done by superimposing a regularly patterned dot grid over the structure drainage area delineated on a topographic map and making the three above mentioned observations at each point. Approximately 7.5 percent of the drainage area was sampled in each case.

Soil "K" factors for 95 percent of the soils in structure drainage areas were between .37 and .43. The valley soils with "A" slopes were recognized as having very low "K" factors. A weighted average "K" factor of .40 was chosen for sloping soils. The rainfall-erosion index for the watershed is approximately 200.

-Analyses - Geology-

Information on current and projected future cropping patterns in structure drainage areas was obtained through discussions with local Service personnel. Expected trends are for less intensive use of currently cultivated areas. The following assumptions were made in calculating the effects of such trends on sheet erosion rates following structure installation: (0-10 years) no land use change, (10-30 years) 95 percent conversion of cultivated slopes greater than 8 percent to permanent vegetation, (10-30 years) 8 percent application of needed land treatment on cultivated slopes less than 8 percent and (30-100 years) no further change. Soil loss predictions for the three periods were computed for each watershed and a weighted average annual soil loss determined.

Weighted average annual soil losses for each structure drainage area were adjusted for the 100 year project life, the watershed delivery rate (modified Roehl Curve) and reservoir trap efficiency in determining reservoir sediment storage requirements.

Channels - Geologic evaluation of the Anderson River channels was undertaken to determine the suitability of flood plain soils for channel work alternates considered in the plan formulation process. Twenty-eight soil borings were made along a 14.8 mile reach of channel and samples taken of each type of soil encountered. The entire length of channel from Saint Meinrad to the Ohio River was floated to evaluate geologic and hydrologic conditions.

The entire reach of channel floated tends to be fairly deep with a depth to top width ratio of approximately 1 to 6. Channel banks are stable except where large trees or debris blocks divert channel flow or where protective vegetation is lacking, particularly on sharp, outside curves. The channel bottom appears to be undergoing cycles of aggradation and degradation that are controlled by the regimen of the stream.

The soils along the main channel are composed of flood plain alluvium consisting of interlayered and lensed CL, ML, and SM materials. The silty soils generally have plasticity indices below 10 and the clays have plasticity indices between 10 and 15.

The scope and intensity of channel investigation was limited because of the minor amount of channel work proposed in this plan and the low "with project" flow velocities. Further investigation during design will involve point stability analysis at selected locations where trees and debris blocks are removed.

Flood plain surveys were conducted to obtain physical data regarding areal extent, rate and degree of damage caused by sediment and erosion. These surveys were conducted by the mapping method in accordance with Section 3, Sedimentation, SCS National Engineering Handbook. Infertile overwash, swamping, stream bank erosion and valley trenching were determined to be relatively minor problems with flood plain scour representing the most serious form of land damage present.

Engineering

Structures - Over 160 structure sites were studied during the plan formulation process for local and overall project effect. The 42 structures included in this plan represent the most cost effective combination of structures meeting objectives within the constraints of economic feasibility, local acceptability and affordability.

Structure site selection was based on review of U.S.G.S. topographic maps, field reconnaissance, field surveys on structure Nos. U-1 and U-19, and geologic reports. Multiple purpose structure Nos. U-1 and U-10 were located to satisfy recreational needs of sponsors in their respective areas of jurisdiction. All other structure sites were chosen to maximize hydrologic effects in key flood damage areas.

Flood control storage incorporated in structure designs is based on principal spillway runoff volumes (Method 2) from Chapter 21, Section 4, Hydrology Guide (Revised January, 1971) and on emergency spillway and freeboard rainfall and design criteria from SCS Engineering Memo 27. Indiana Department of Natural Resources freeboard rainfall criteria was used when it exceeded that specified in SCS Engineering Memo 27. Recreation storage provided in structure No. U-10 was coordinated with recommendations from Midwestern Engineers, Inc., consultants representing the Perry County Park and Recreation Board. Such storage in structure No. U-1 was coordinated with expressed interests of the U.S. Forest Service. Water supply storage and specific water supply outlet features incorporated into the designs of structure Nos. U-1 and L-24 were in accordance with recommendations of Midwestern Engineers, Inc., consultants representing both the Town of Birdseye and the Saint Meinrad Archabbey respectively. All plans prepared by others were reviewed by the Service for reasonableness and technical adequacy.

Most practical size principal spillway conduits for use on planned small structures was determined through alternate studies. Various combinations of pipe size, conduit length and fill volume were analyzed for possible cost savings. Pipe diameters of 16, 18, 24, 30 and 36 inches was considered in this study using structures on a variety of drainage areas ranging in size from one half to two square miles. Eighteen inch diameter pipe systems were found to be most practical and were therefore used in the design of small structure principal spillway systems.

Principal spillway risers on all structures were designed with two stage inlets for maximum downstream flood reduction effects. A study was made to determine the most economical low stage floodwater storage and release rate for such risers. Seven alternate designs were analyzed using the 18 inch diameter principal spillway pipe from the above study on a single grouping of small structures. Those designs analyzed are shown below. A 6 c.s.m quick return flow was used in structure routings of all alternates.

-Analyses - Engineering-

<u>System</u>	<u>Low Stage Flood Storage</u>	<u>Release Rate</u>
1	0.5 inches	5 c.s.m.
2	1.0 "	5 "
3	1.0 "	4 "
4	1.5 "	5 "
5	2.0 "	5 "
6	2.5 "	5 "
7	18" hooded inlet pipe	5 "

Each of the above design runs were flood routed through the Hurricane sub-watershed for purposes of incremental benefit-incremental cost determinations. Incremental benefits accruing within the subwatershed were expanded by a factor to reflect benefits to the structural system accruing throughout downstream reaches of the project. Comparisons obtained indicated that system 3 provided the most cost effective design for downstream flood control. Structures in this plan are therefore designed with one inch of low stage flood storage and a low stage release rate of 4 c.s.m.

Multiple level release features on structure Nos. U-1 and U-10 principal spillway risers are provided in accordance with recommendations from cooperating fish and wildlife agencies as a mitigating feature for stream fisheries lost in structure pool areas. A model study may be needed on structure No. U-1 principal spillway riser to assure proper design, as such riser is approximately 70 feet high.

The SCS "Dams" computer program was used to flood route and proportion all structures. The sediment pools of all structures include the full 100 year submerged sediment volume.

The control sections of emergency spillways on structure Nos. U-1 and U-10 will be constructed in sandstone with minor interbedded layers of limestone and shale, thereby providing excellent protection against breaching forces. Emergency spillways will be located to cause minimal disturbance to the natural environment of the structure sites.

Fencing on those small structures subject to pasture activity has been provided for the protection of dam, emergency spillway and wildlife habitat mitigation areas. Local sponsors identified those structure sites on which pasturing might occur.

To satisfy current earthquake criteria for class I, low intensity, seismic activities in southern Indiana, all class "c" dams are planned with 1) 25 percent greater top widths, 2) 0.5 flatter side slopes than required for stability, and 3) 5 percent added to the total height of the dams. Class "b" dams are planned with 25 percent greater top widths than required. No special measures were taken on class "a" dams.

Samples of borrow material for structure No. U-1 were collected and submitted for soil mechanics analysis. Test results, together with numerous conferences with Service engineering personnel at the State and regional level, yielded a consensus of opinion with regard to the consolidation potential of the

foundation and the placement of fill in the embankment. Major points of consensus included the following: 1) fine grained soils overlying the foundation should be removed to reduce settlement of the dam, 2) fill should be placed in the embankment at 95 percent proctor density on a $3\frac{1}{2}$ to 1 upstream slope and a 3 to 1 downstream slope and 3) tight terrace CL materials should be used in the structure core trench and center core of the embankment to assure waterholding capability.

Borrow samples were also collected for structure No. U-10. Such samples were found to compare closely with those for structure No. U-1. Planning design for structure No. U-10 was therefore closely patterned to that of structure No. U-1.

Construction costs for all structures were estimated using price information from recent contract bidding on adjacent and state-wide P.L. 566 projects. Such costs for municipal and industrial water supply outlet features and recreational developments were prepared by consultants and/or other agencies. Land rights costs were determined by local sponsors and concurred in by the Service. In arriving at land rights cost, consideration was given to tax records of land and building values and to recent market transactions.

Acquisition line for land rights on single purpose structures was taken to be coincident with the higher elevation of a) the crest of the emergency spillway or b) the crest of the emergency spillway hydrograph.

Operation and maintenance costs for each of the single purpose structures was set at an average of \$75.00. This reflects an effort to minimize wildlife habitat disturbance through maintenance operations and to utilize a realistic cost. Recent studies of some 57 well maintained small CO-01 or P.L. 46 structures in southern Indiana averaging about 100 acres in drainage area, show an average operation and maintenance cost much below the \$75.00 figure. Operation and maintenance costs for multiple purpose structures U-1, U-10 and L-24 were estimated at comparable levels to similar measures in other watersheds. Such costs for specific water supply outlet features and planned recreational developments were provided by consultants or other agency personnel.

Channels - Several channel designs were studied along with the numerous structure combinations. Designs ranged from a complete cleanout of the main Anderson River channel and Blackhawk tributary to a trash and debris removal operation on only a portion of the main channel. Evaluation of the several designs revealed that main channel trash and debris removal from the junction of Hurricane Creek downstream to the Town of Huffman best satisfied project objectives.

Bank full flow velocities through the planned channel work reach did not exceed 1.9 feet per second under "with project" conditions. This velocity is within the range of allowable flow velocities set forth in TR-25 for soils present in the Anderson River flood plain. Bridge capacities at bank full elevations are adequate for design flows.

-Analyses - Biology-

The construction costs estimated for the channel work include removal of fallen trees, snags and log jams, disposal of removed material by burying or stacking with tie down, installation of surface water pipes as needed, scour hole protection at critical points and land easements for removal, disposal and maintenance operations. Future annual operation and maintenance costs for planned channel have been estimated based on expected annual trash and debris removal work.

Biology

Biology aspects of the watershed were reviewed by an interagency team of personnel from the Indiana Department of Natural Resources, Division of Fish and Wildlife, the U.S. Department of the Interior, U.S. Fish and Wildlife Service and the Service. Basic inventory data was obtained from field studies conducted in and near the watershed by Indiana Department of Natural Resources and Indiana University personnel. Such studies included rural letter carrier game surveys, spring crowing counts and sportsman questionnaires.

Recommendations relating to planned project measures were made following a joint field inspection by representatives of the above agencies. Such recommendations were reviewed with local project sponsors and are incorporated within the body of this plan under the appropriate sections. (See Section on Environmental Considerations, Page 46).

Water Quality

A water quality study was conducted by the U.S. Geological Survey. (20) Their objective was to assess the general quality of surface waters in the Anderson River Watershed.

Water samples were analyzed from 19 sites, primarily from areas identified as potential development areas identified in the Anderson River Watershed Work Plan.

Onsite analysis were conducted to determine temperature, specific conductance, pH, dissolved oxygen, and an estimate of stream discharge. Further analysis of the samples in the laboratory included some or all of the following parameters: common inorganic constituents, metals (aluminum, iron, and manganese); nutrients (nitrogen and phosphorous); bacteria, insecticides; and sediment concentrations.

Anderson River streambed samples were taken above Kitterman's Corners and at St. Meinrad for insecticide analysis.

In general the quality of surface water in the Anderson River Watershed is very good. However, some problem areas were identified. These include isolated instances of somewhat high concentrations of nitrates, fecal coliform, fecal streptococci, and suspended sediment. At three locations, abandoned surface coal mining operations were causing alterations of stream water quality downstream. These effects were low pH, high specific conductivity, and increased concentrations of aluminum, iron and manganese.

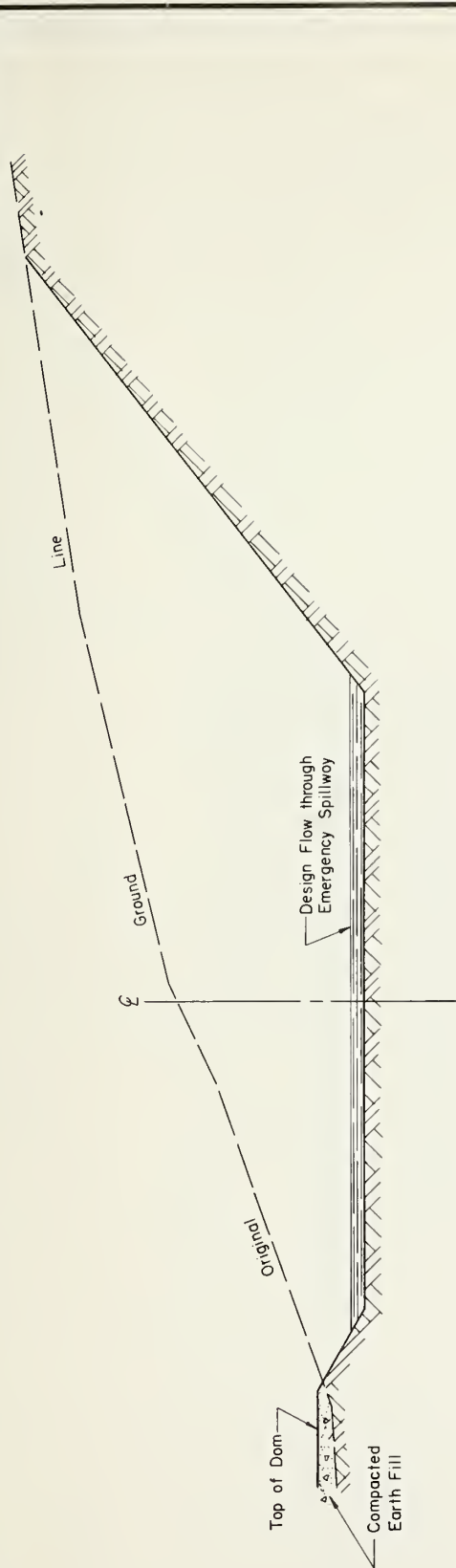
It should be noted that the sampling was conducted during January after a snow melt and stream discharge was fairly high. This might indicate that concentrations of suspended sediment, fecal bacteria and nitrate content could be expected to be lower during periods of low flow because of reduced surface runoff. At the same time concentrations of fecal coliform might be expected to be higher because its source is fairly constant.

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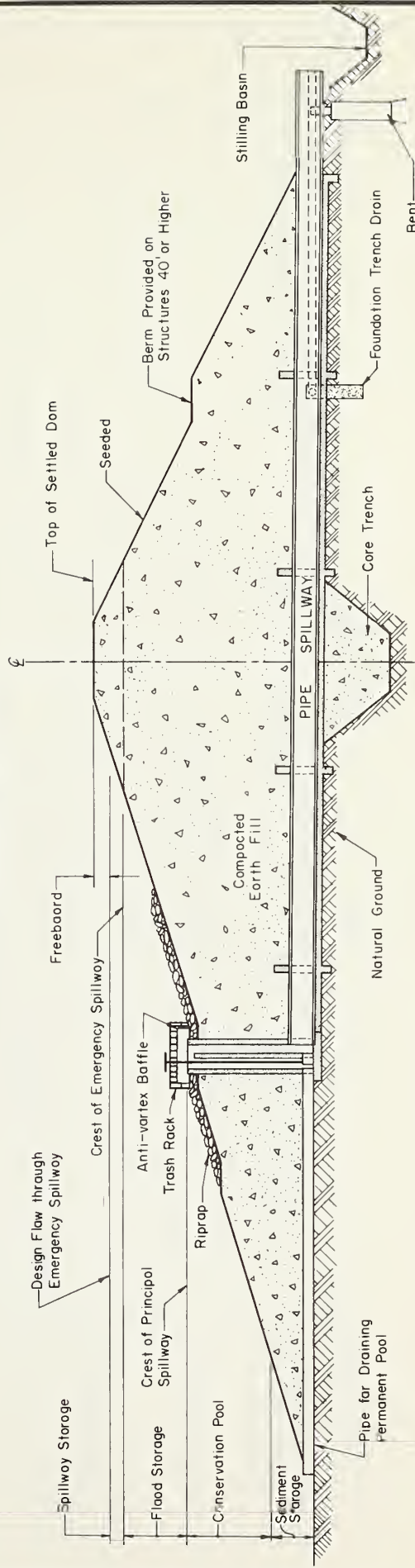
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- 10/ Indiana Department of Commerce. Economics Research Division. Indiana Fact Book. October, 1971. Excerpts from Table 10, Pages 17-19.
- 11/ U.S. Department of Commerce. Bureau of the Census. 1970 Census of Population, General Population Characteristics, "Indiana". Washington, D.C.: Government Printing Office. Excerpts from Table 35, pages 16-159 through 16-181, and Table 19, Page 16-61.
- 12/ U.S. Department of Commerce. Social and Eccnomic Statistics Administra-tion. Bureau of the Census. 1969 Census of Agriculture, Part II, "Indiana". Volume 1, Section 1, Summary Data and Section 2, County Data. Washington, D.C.: Government Printing Office. Excerpts from Table 3, Page 3.

- 13/ U.S. Department of Commerce. Bureau of the Census. Social and Economic Statistics Administration. 1970 Census of Population, General Social and Economic Characteristics, "Indiana". Washington, D. C.: Government Printing Office. Excerpts from Table 124, Pages 16-519 through 16-526, and Tables 57 and 28 Pages 16-251 through 16-254.
- 14/ Indiana Employment Security Division. Work Force Summaries for Smaller Counties in Indiana, Annual Average, 1970.
- 15/ Indiana Department of Commerce. Economics Research Division. Indiana Fact Book. October, 1971.
- 16/ Indiana Department of Conservation and the Indiana University Department of Zoology. Investigations of Indiana Lakes and Streams. Indiana University, 1945.
- 17/ This information was acquired during a personal interview in December, 1973 with deer biologist Mr. John Olson of the Indiana Department of Natural Resources, Division of Fish and Wildlife.
- 18/ Sites of possible archeologic interest were located on topographic maps at the request of the Soil Conservation Service by Dr. James Kellar of the Glen Black Laboratory, Indiana University, Bloomington, Indiana, 1972.
- 19/ U.S. Department of Commerce. Social and Economic Statistics Administration. Bureau of the Census. 1969 Census of Agriculture, Part II, "Indiana". Volume 1, Section 1, Summary Data and Section 2, County Data. Washington, D. C.: Government Printing Office. Excerpts from Table 1, Pages 9 through 744.
- 20/ U.S. Department of Agriculture. Soil Conservation Service. Predicting Rainfall and Erosion Losses from Cropland East of the Rocky Mountains. Agricultural Handbook No. 282. Agricultural Research Service and Purdue Experiment Station. Washington, D. C.: Government Printing Office, 1965.
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- 22/ Indiana Department of Natural Resources. Outdoor Recreation Division. The Indiana Outdoor Recreation Plan 1970-1975. September, 1970.
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- 24/ Ohio River Basin Comprehensive Survey, Final Field Review Draft.
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- 26/ U.S. Department of Health, Education, and Welfare. Environmental Health Practice in Recreational Areas. HEW Pub. No. (HSM) 92-10009, February, 1972.
- 27/ Great Lakes, Upper Mississippi River Board of Sanitary Engineers. Recommended Standards for Sewage Works. Albany, N. Y. Health Education Service, 1971.
- 28/ General Assembly of Indiana. "The Indiana Conservancy Act" (and Amendments). Enacted March 14, 1957.
- 29/ General Assembly of Indiana. "The Indiana Conservancy Act" (and Amendments). Enacted March 14, 1957.

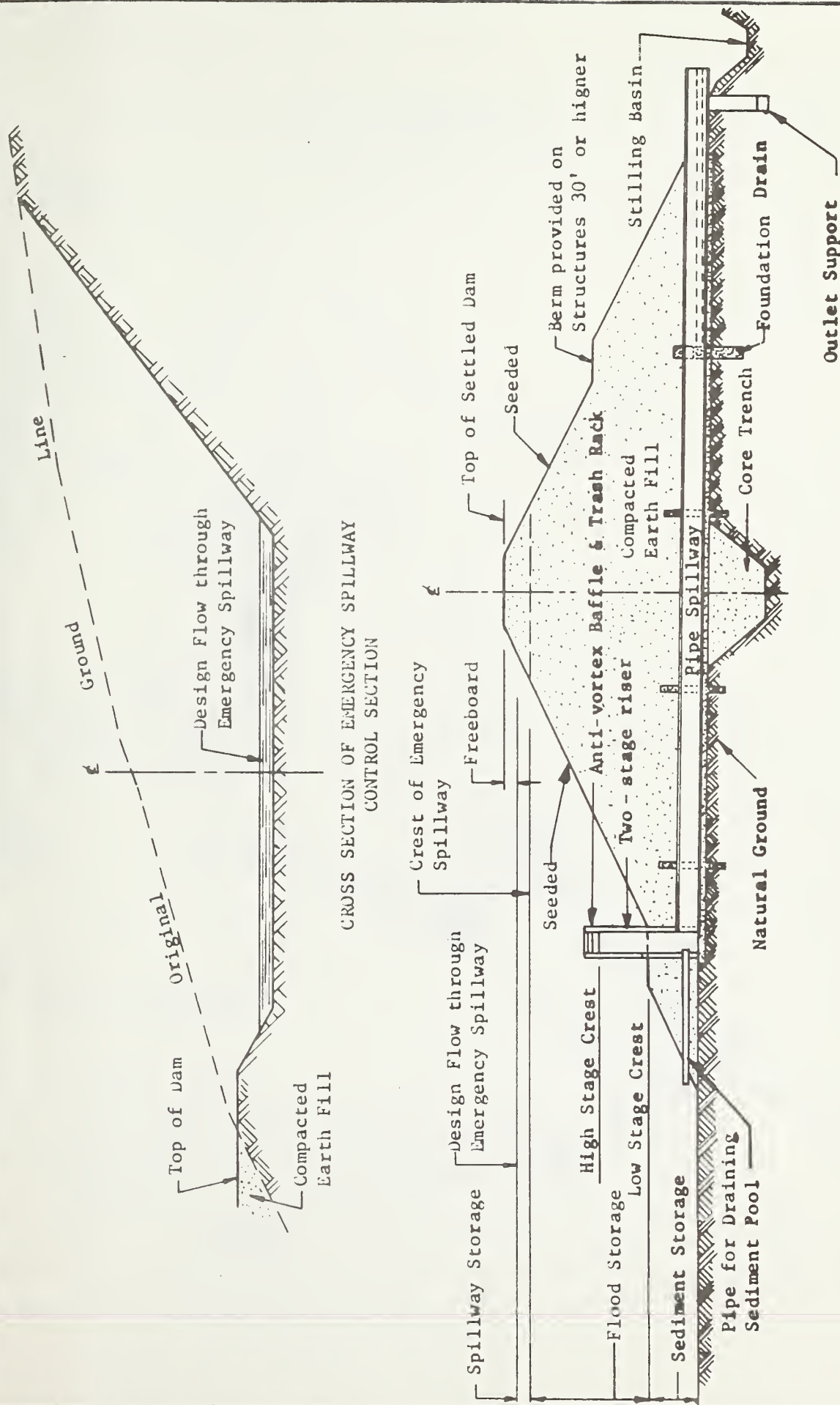


CROSS SECTION OF EMERGENCY SPILLWAY
CONTROL SECTION

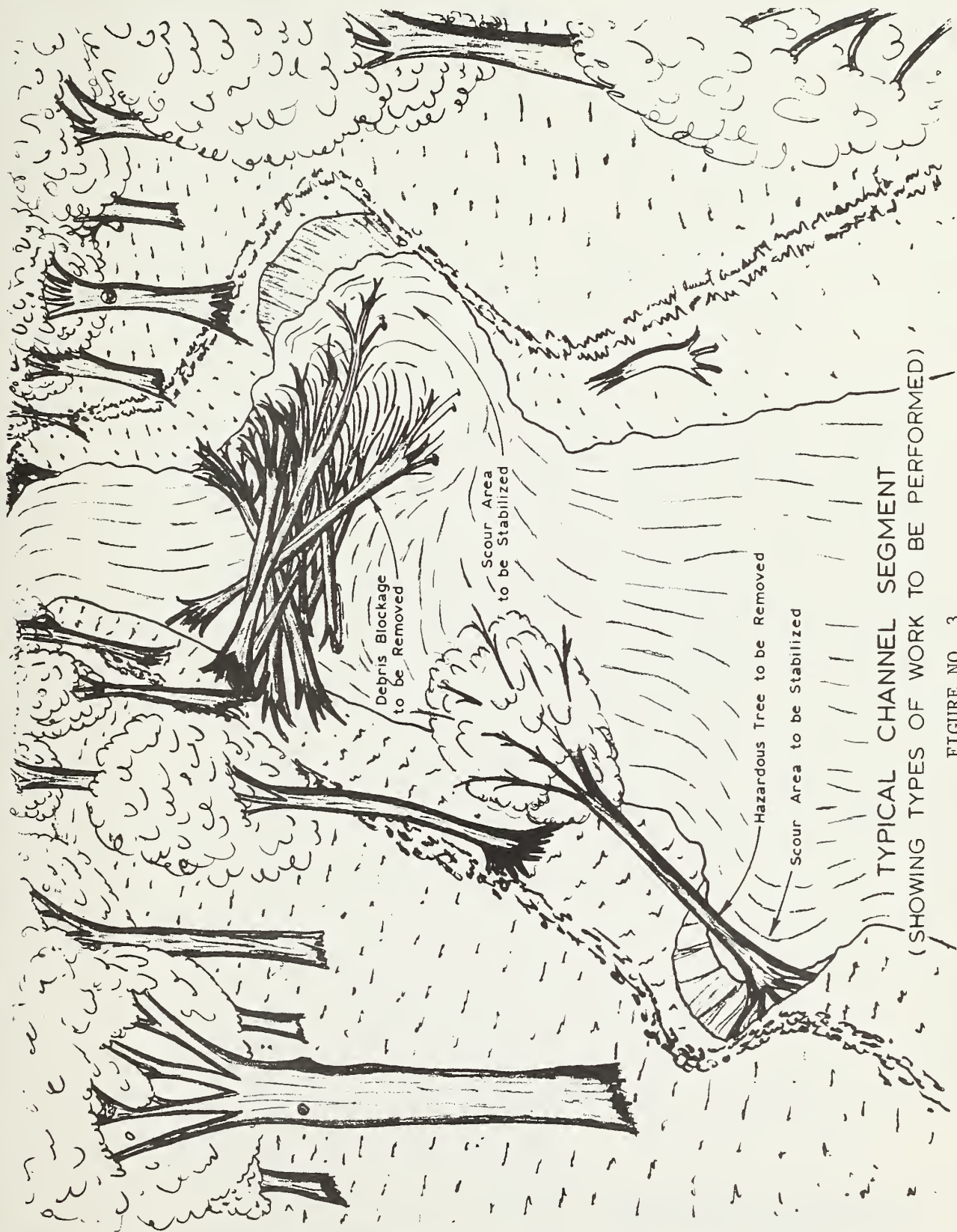


CROSS SECTION OF TYPICAL MULTIPLE PURPOSE STRUCTURE
ALONG PRINCIPAL SPILLWAY

Figure 1



CROSS SECTION ALONG PRINCIPAL SPILLWAY
OF TYPICAL SINGLE PURPOSE STRUCTURE



TYPICAL CHANNEL SEGMENT
(SHOWING TYPES OF WORK TO BE PERFORMED)

FIGURE NO. 3

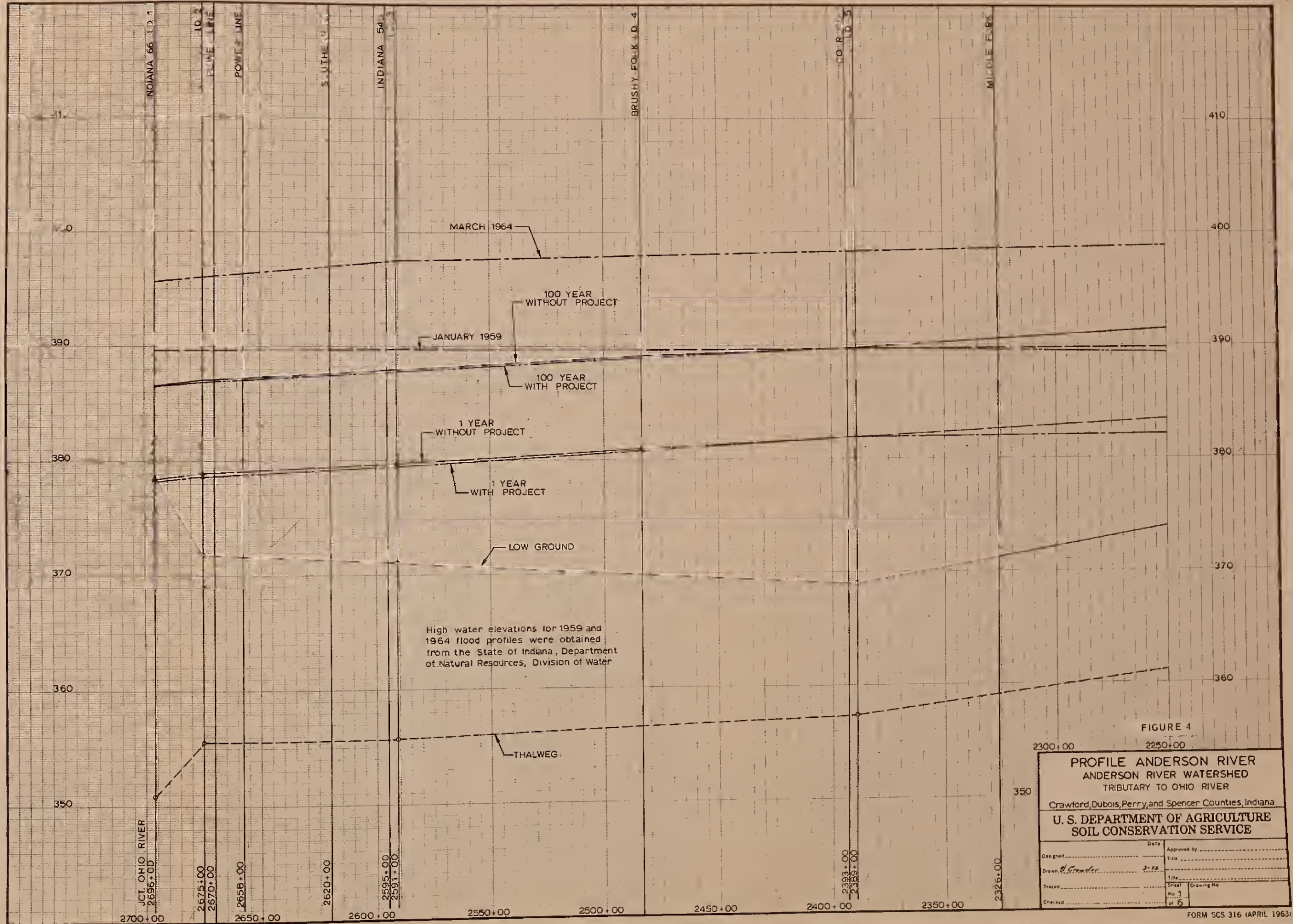


FIGURE 4

2300+00 2250+00

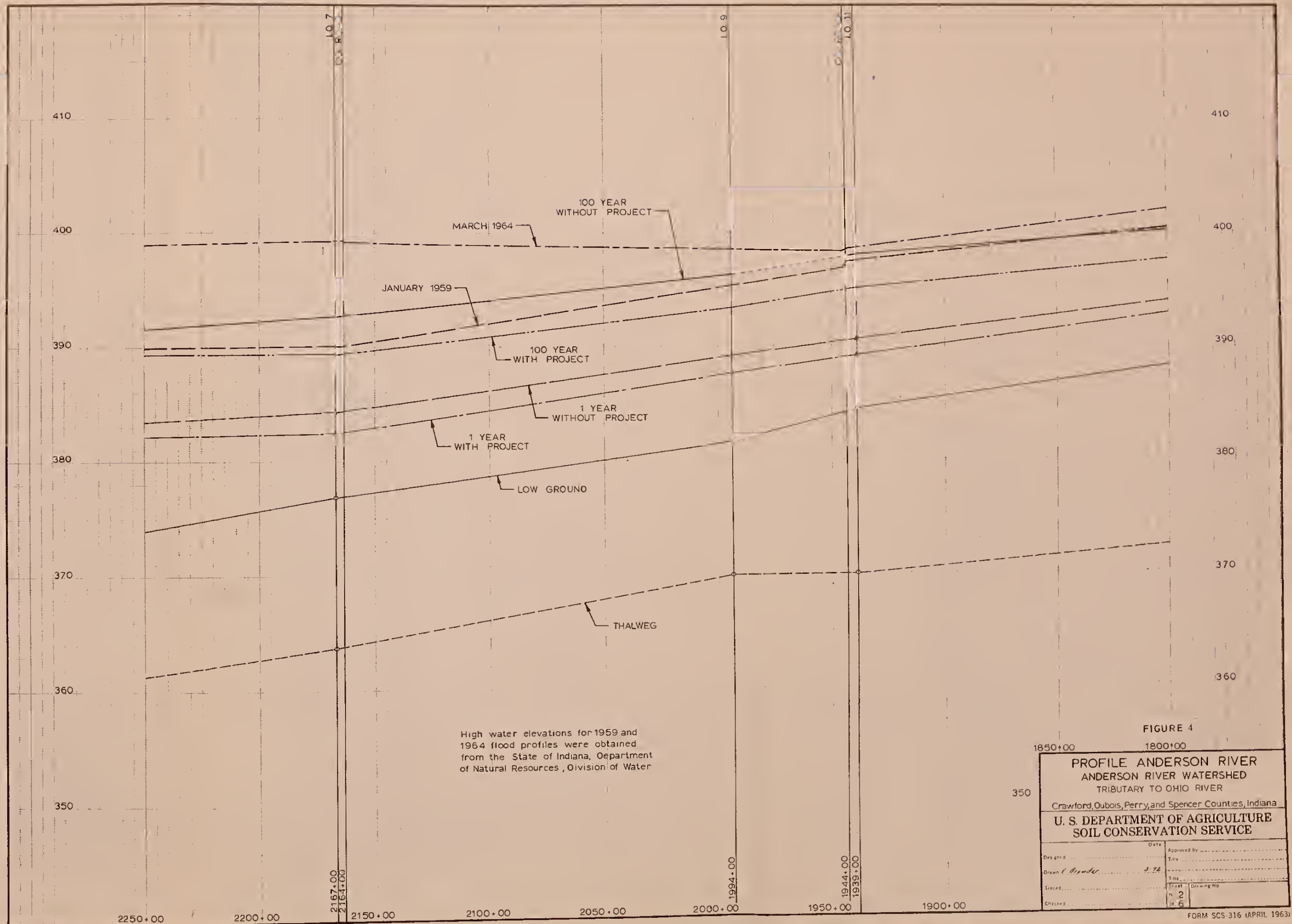
350

PROFILE ANDERSON RIVER
ANDERSON RIVER WATERSHED
TRIBUTARY TO OHIO RIVER

Crawford, Dubois, Perry, and Spencer Counties, Indiana

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed.....	Date.....	Approved by.....
Drawn <i>H. Crandall</i>	3-18	Title.....
Traced.....	Sheet No. 1	Drawing No.....
Checked.....	of 6	



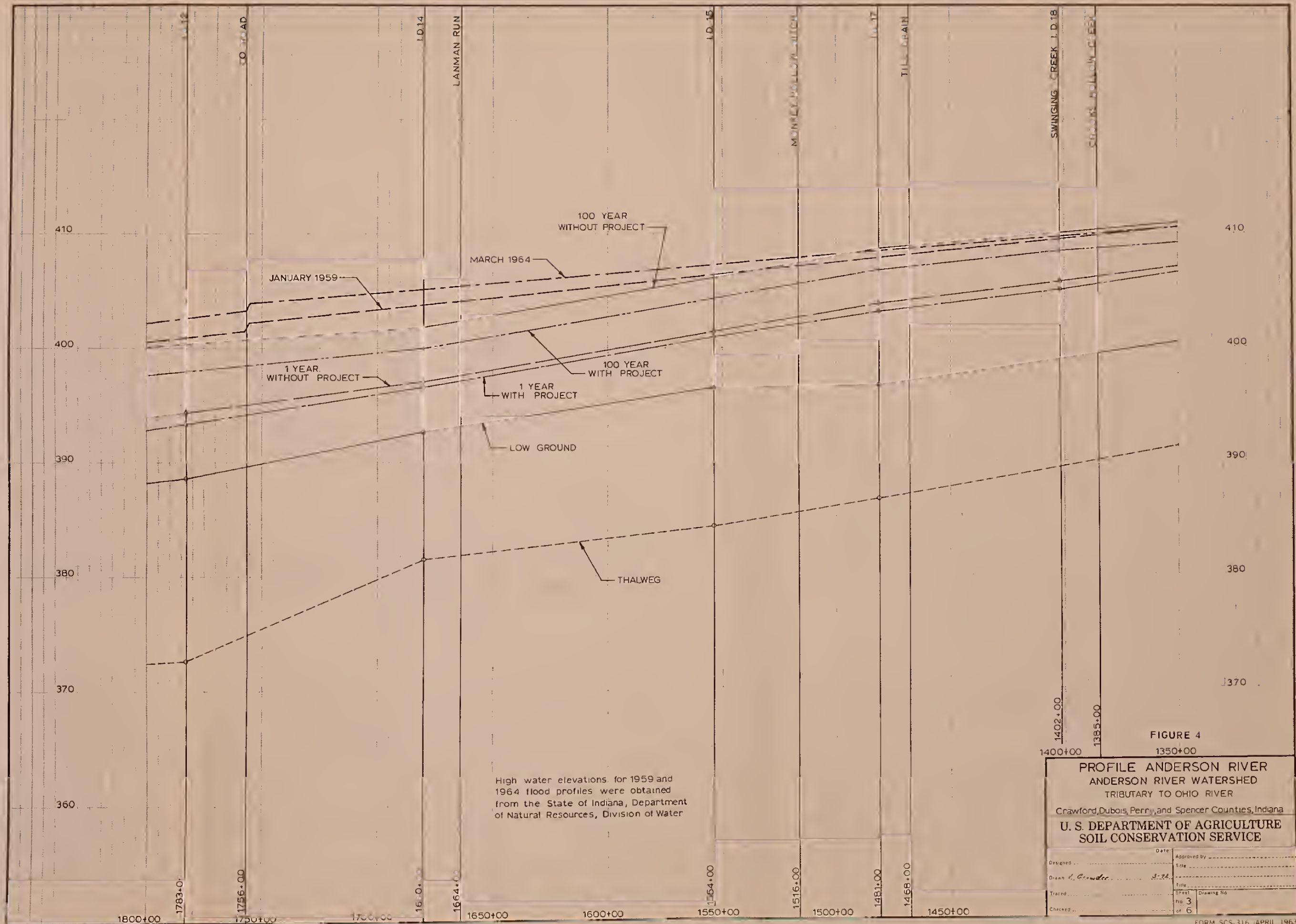
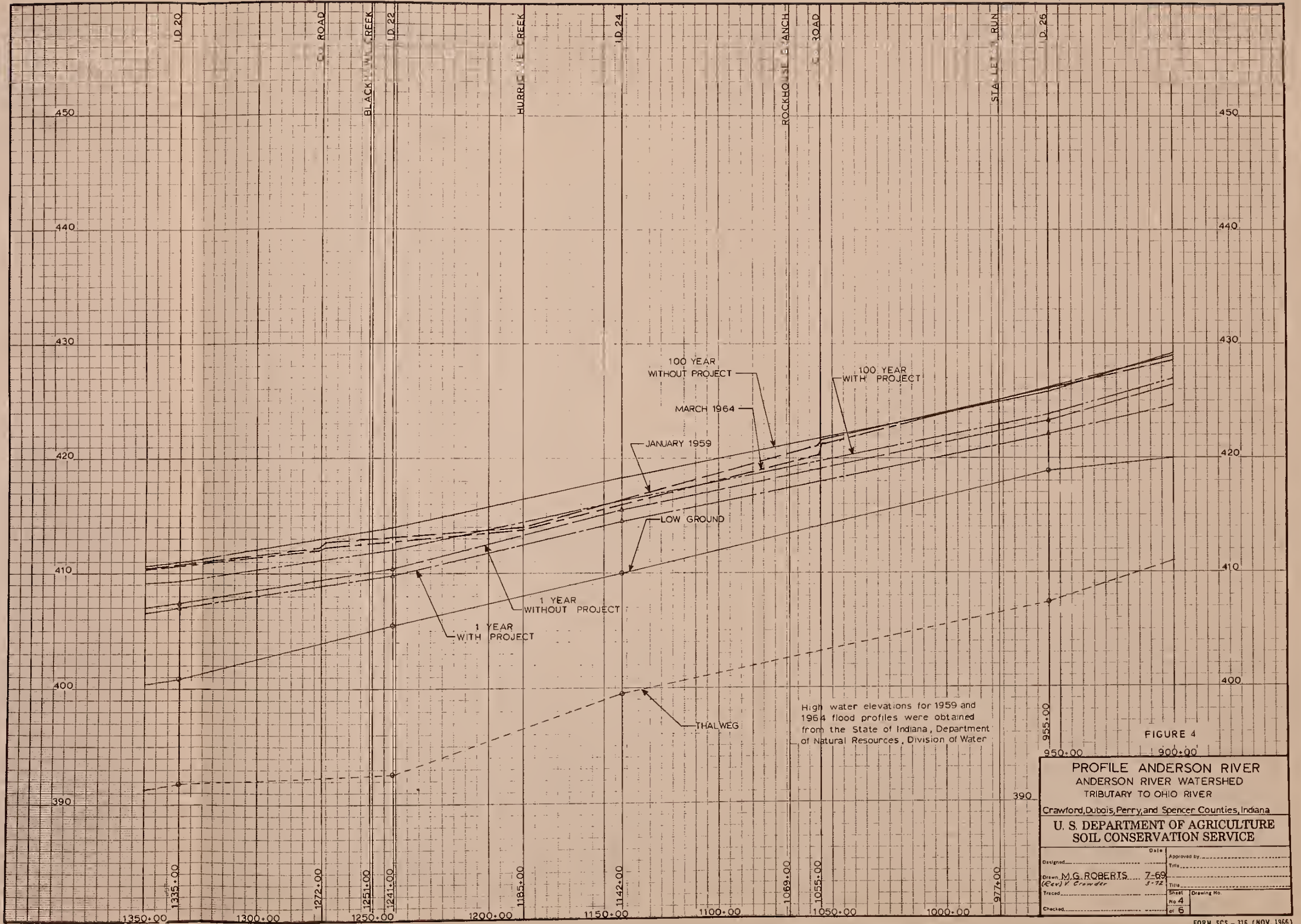


FIGURE 4

PROFILE ANDERSON RIVER
 ANDERSON RIVER WATERSHED
 TRIBUTARY TO OHIO RIVER
 Crawford, Dubois, Perry, and Spencer Counties, Indiana

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by
Drawn <i>V. Crowder</i>	Scale <i>2-1/2"</i>	Title
Traced	Sheet <i>3</i>	Drawing No.
Checked	of 6	



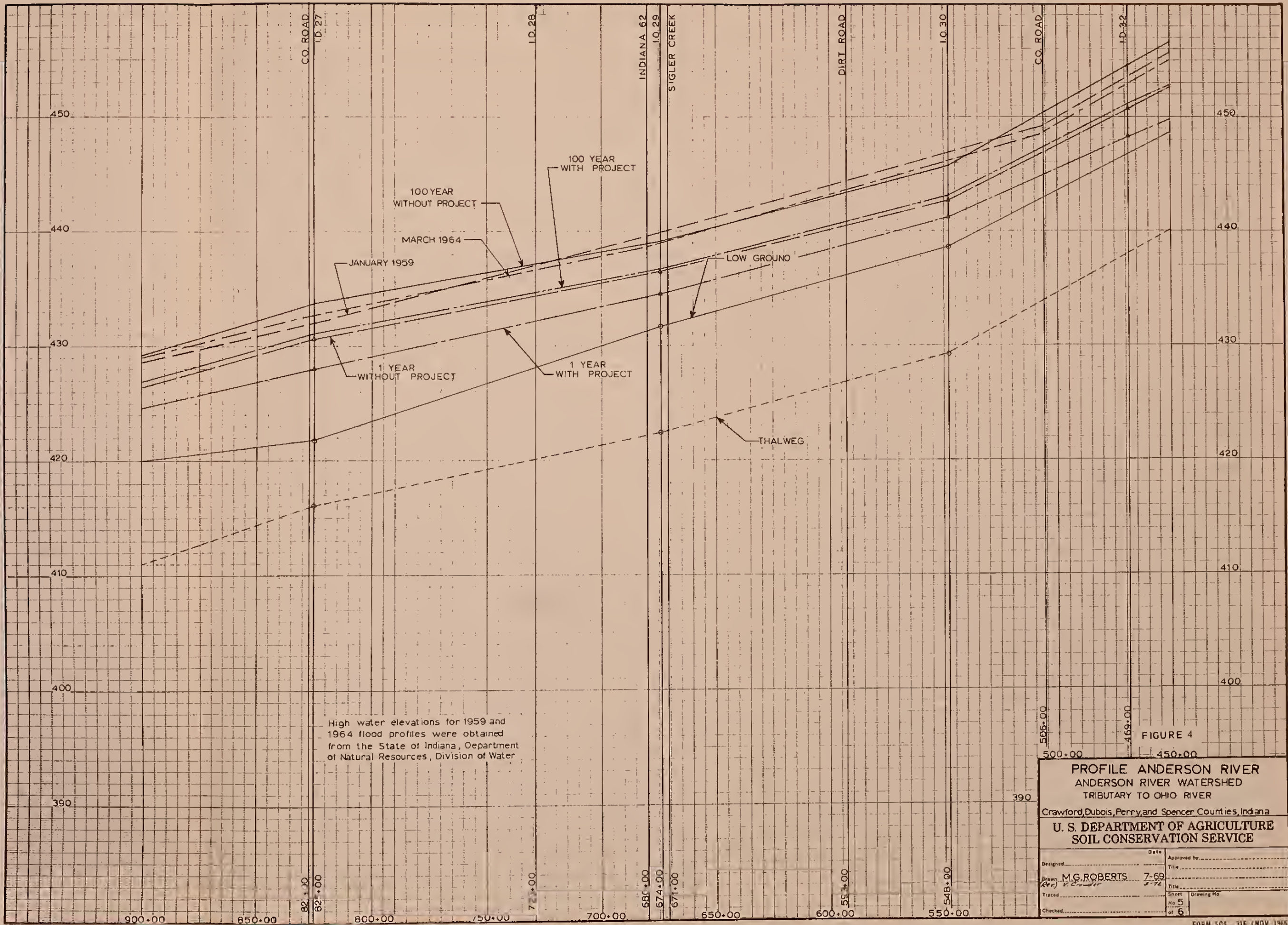


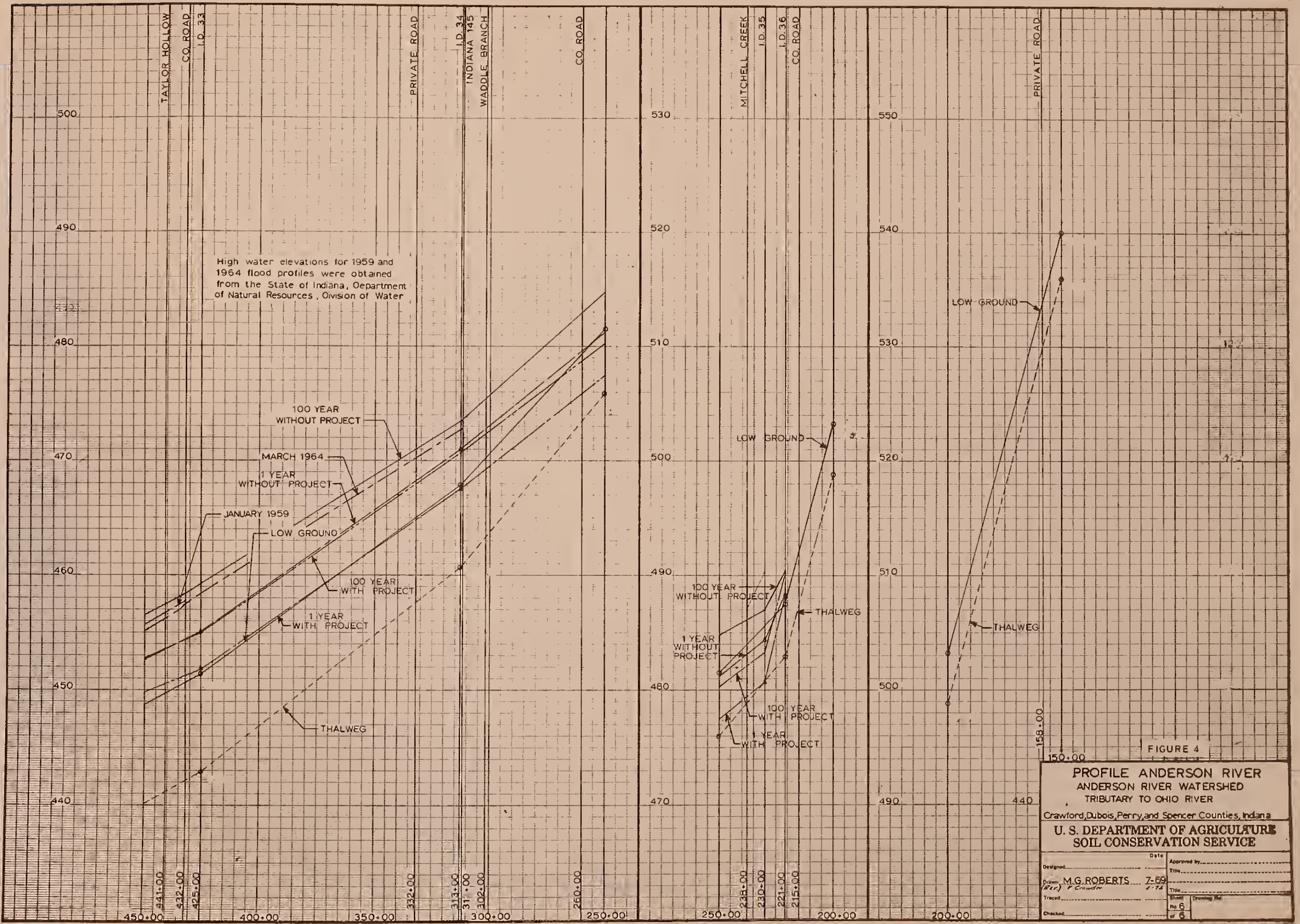
FIGURE 4

508+00 469+00 500+00 450+00

390

PROFILE ANDERSON RIVER
 ANDERSON RIVER WATERSHED
 TRIBUTARY TO OHIO RIVER
 Crawford, Dubois, Perry, and Spencer Counties, Indiana
 U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

Designed	Date	Approved by
Drawn M.G. ROBERTS	7-69	Title
Traced	Sheet No. 5 of 6	Drawing No.
Checked		







CRITICALLY ERODED AREA 3/16/61
 3 1/2 miles southeast of Eckerty, Indiana.
 Has been planted to trees as of 1/31/67.



CRITICAL AREA TREE PLANTING
 Tell City Junior Chamber of Commerce





FARM BUREAU CO-OP GRAIN BINS
St. Meinrad, Indiana
May 2, 1967



U. S. MAIL CAR - ONE MILE S.E. OF ST. MEINRAD
May 6, 1967



ANDERSON RIVER FLOODING BOTTOM CROPLAND



SITE OF STRUCTURE NUMBER 1
Future U. S. Forest Service Recreational Development



SADDLE LAKE
RECREATIONAL DEVELOPMENT
Structure No. 1, Middle Fork of Anderson River



HUFFMAN COVERED BRIDGE
Spans
Anderson River
Built in 1865



1/4 ACRE LIVESTOCK AND RECREATION POND AND WILDLIFE PLANTING



STOCKING A FARM POND WITH BASS FINGERLINGS



SOURCE
 DRAWING FURNISHED BY FIELD TECHNICIANS

USDA-SCS-LINCOLN, NEBR. 1973

5-6-70
 5,5-28,226

TREES WILL BE LEFT UNCLEARED TO PROVIDE
HABITAT FOR FISH AND WILDLIFE AND TO PROVIDE
HARVEST AREAS FOR FISHERMEN AND HUNTERS

R - 3 - W R - 2 - W

14 13 23 24 COUNTY COUNTY
DUBOIS PERRY
13 18 24 19
FERDINAND STATE FOREST

FERDINAND

STATE

FOREST

FOR DETAILS OF RECREATIONAL
DEVELOPMENT SEE FIGURE 12

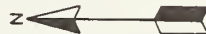
RECREATION POOL - ELEVATION 48DD
(CREST)
EMERGENCY SPILLWAY - ELEVATION 495.1
PURCHASE AREA BOUNDARY (MINIMUM)

INDIANA

T 18 17 19 20
3
S

LEGEND

- COUNTY LINE
- FERDINAND STATE FOREST BOUNDARY
- RECREATION POOL 480.0
- EMERGENCY SPILLWAY 494.0
- PURCHASE AREA BOUNDARY (MINIMUM)
- RECREATIONAL FACILITIES BOUNDARY
- STRUCTURE
- GRAVEL ROAD
- PRIVATE ROAD
- SECTION CORNER



SCALE 1/2" = 1000 FEET
0 500 1000 1500 2000 2500

23 24 26 25
24 19 25 30

FIGURE 11

ANDERSON RIVER WATERSHED

CRAWFORD, DUBOIS, PERRY AND SPENCER COUNTIES, INDIANA
STRUCTURE NUMBER 10



LEGEND

- ① ENTRANCE AND GATE HOUSE
- ② TRAILER CAMPSITES (60)
- ③ CAMPGROUND BUILDING WITH SHOWERS, TOILETS, AND DUMPING STATION Δ
- ④ PLAYGROUND
- ⑤ PICNIC AREA • PICNIC TABLES
- ⑥ SHELTER HOUSE
- ⑦ WATER STATION ○
- ⑧ FLUSH TOILETS
- ⑨ BOAT DOCKS
- ⑩ BOAT LAUNCHING RAMP
- ⑪ BEACH HOUSE
- ⑫ BEACH AREA
- ⑬ DIVING RAFT
- ⑭ SHELTER HOUSE WITH TOILETS
- ⑮ NATURE TRAIL
- ⑯ PATH
- ⑰ REFUSE STATION •
- ⑱ OBSERVATION POINT
- ⑲ SEWAGE TREATMENT PLANT
- ⑳ PARKING

INDIANA



FIGURE 12

ANDERSON RIVER WATERSHED

CRAWFORD, DUBOIS, PERRY AND SPENCER COUNTIES, INDIANA

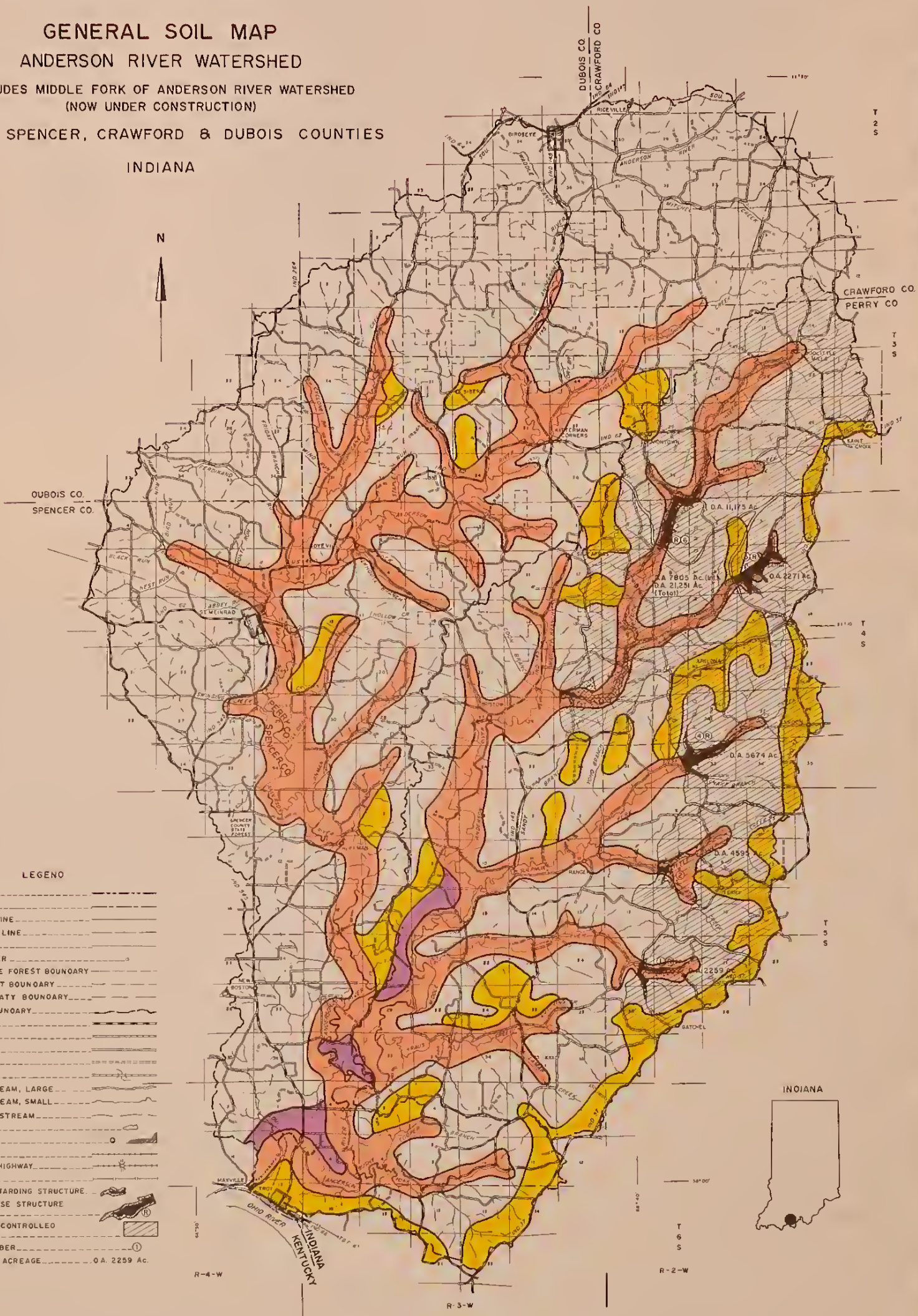
STRUCTURE NUMBER 10

PROPOSED DEVELOPMENT OF RECREATION FACILITIES 2-4-70
5,P-27,868





SOURCE:
BASE MAP FURNISHED
BY FIELD TECHNICIANS
USDA-SCS-LINCOLN, NEBR. 1975

GENERAL SOIL MAP
ANDERSON RIVER WATERSHED

INCLUDES MIDDLE FORK OF ANDERSON RIVER WATERSHED
(NOW UNDER CONSTRUCTION)
PERRY, SPENCER, CRAWFORD & DUBOIS COUNTIES
INDIANA



LEGEND

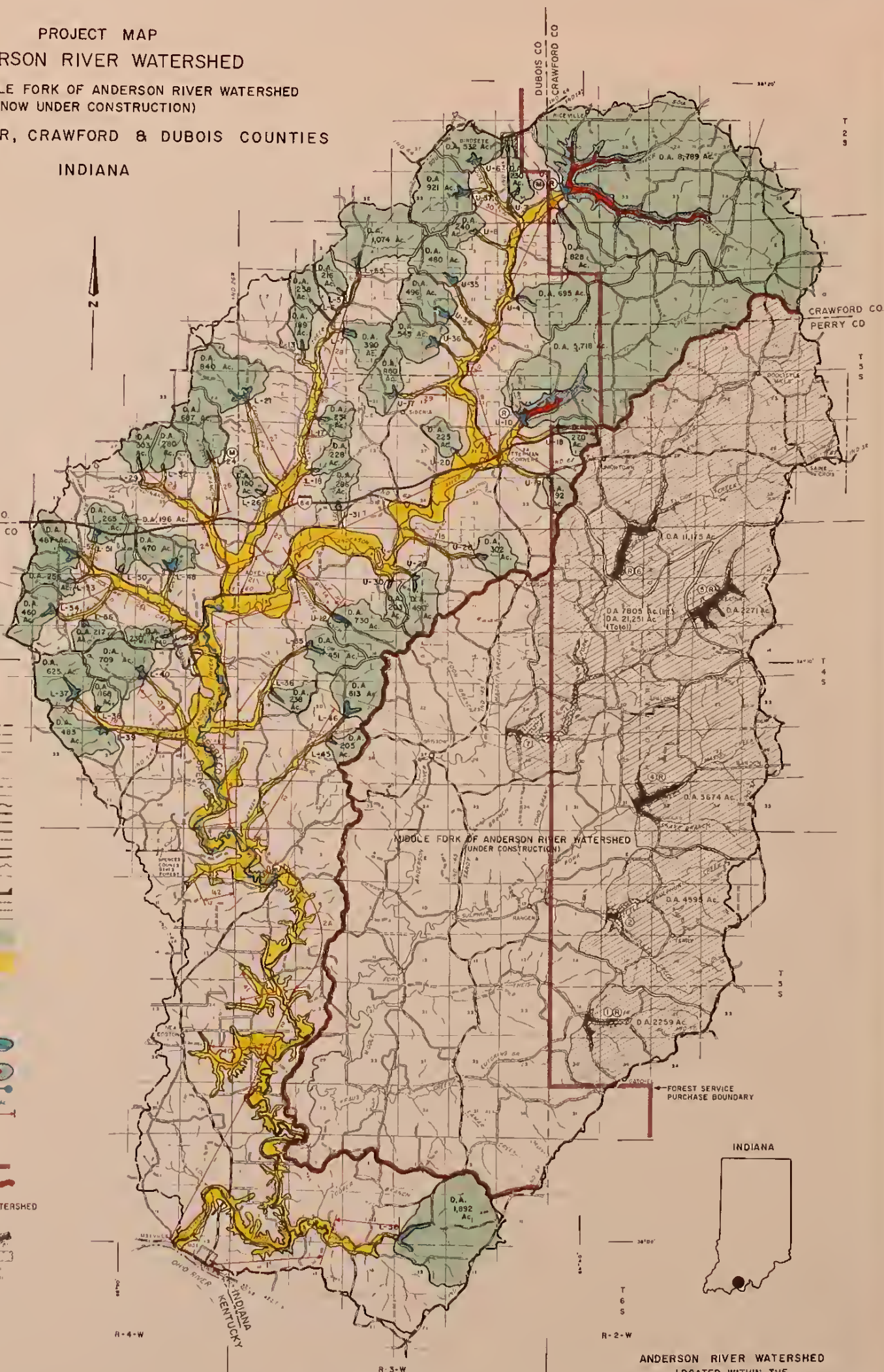
-  CUBA - HAYMOND ASSOCIATION: Deep, well drained, nearly level soils formed from medium textured alluvium on bottoms and low terraces.
-  MARKLAND - McGARY ASSOCIATION: Deep, well and somewhat poorly drained, nearly level soils formed from fine textured lacustrine materials. They occur on terraces near the mouth of Anderson River.
-  ZANESVILLE - TILSIT ASSOCIATION: Deep, well and moderately well drained, gently sloping to moderately sloping soils formed from loess over sandstone residuum on the ridge tops of the upland.
-  GILPIN - BERKS ASSOCIATION: Deep and moderately deep, well drained, strongly sloping to very steep soils formed from sandstone residuum on the side slopes of the upland.

POLYCONIC PROJECTION

SCALE 4000 0 4000 8000 12000 FEET
SCALE 1/41,000

GENERAL SOIL MAP
ANDERSON RIVER WATERSHED
LOCATED WITHIN THE
LINCOLN HILLS
RESOURCE CONSERVATION AND DEVELOPMENT PROJECT

INCLUDES MIDDLE FORK OF ANDERSON RIVER WATERSHED
(NOW UNDER CONSTRUCTION)
PERRY, SPENCER, CRAWFORD & DUBOIS COUNTIES
INDIANA



ANDERSON RIVER WATERSHED
LOCATED WITHIN THE
LINCOLN HILLS
RESOURCE CONSERVATION AND DEVELOPMENT PROJECT



